People & the Planet

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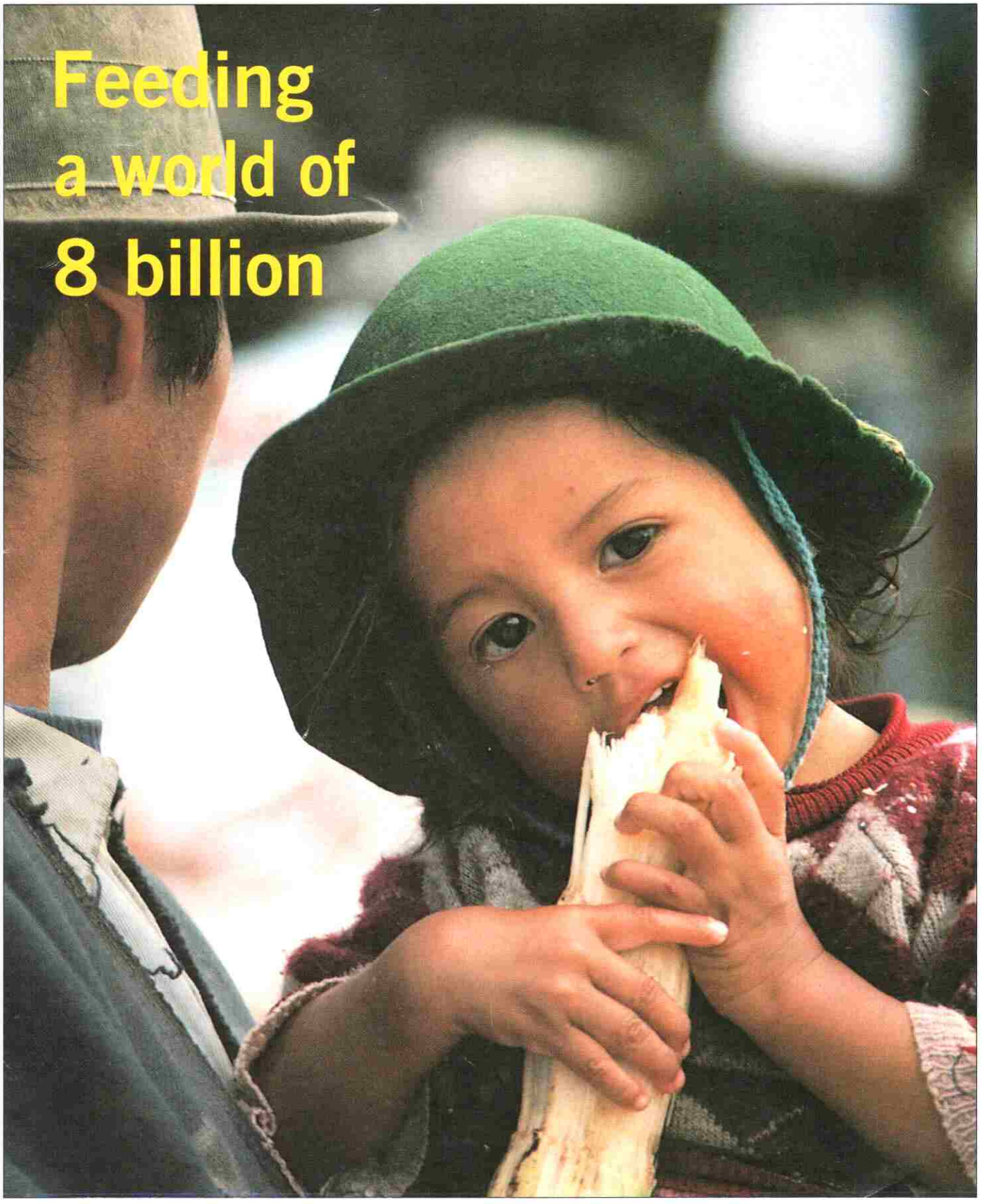
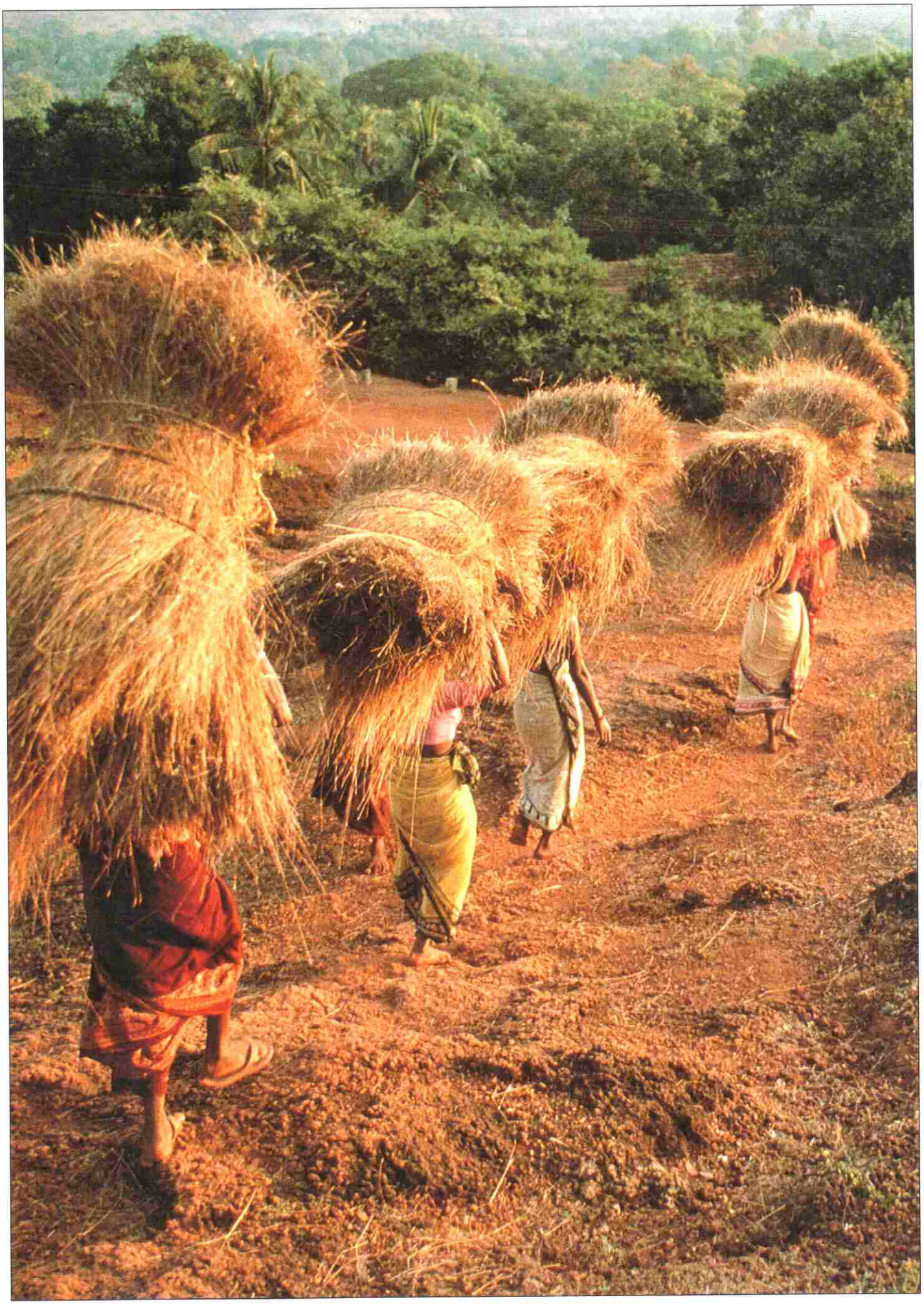


Feeding a world of 8 billion



JORGEN SCHYTTE/STILL PICTURES

Contents

■ **Our next issue reports on the planet's precious mountains - the water towers of the world - and the people trying to protect them.**

4 Newsfile
7 Overview: Feeding 8 billion
John Madeley
10 Must the poor starve?
David and Marcia Pimentel
13 Be wary of gloom
Tim Dyson
15 Energy and food for all
David Hall
18 Foreclosing the future
Gretchen Daily
20 Towards sustainable farming
Jules Pretty
21 Permaculture: a natural way
John Madeley
22 Restoring a fragile land
Fatoumata Batta
23 Planning for sons
Syed Ayub Qutub
24 From nutcases to trendsetters
25 Forgotten foods
26 Essay: Blossoms in the dust
M S Swaminathan
28 Gadfly
29 Associates' News
31 Films
32 Books

Front cover: *Father and daughter in Otavalo, Ecuador. Photograph by Bernard Régent, Hutchison Library.*

Left: *Women farm workers carrying home the rice harvest in the Indian state of Karnataka.*

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People & the Planet

A paralysis of policy

Gretchen Daily, in her thoughtful contribution to our Great Debate on the future food security of our world, points to a "paralysis in the policy arena" caused by the diversity of opinions in the agricultural literature. That diversity also marks our debate, with optimists and pessimists pressing their case about our future ability to feed a world of 8 billion by the year 2020. But that division of opinion is less important than the common themes which emerge from our contributors.

All are agreed that we cannot go on as before. In Dr Swaminathan's words we cannot go on scrambling for greed revolutions in the place of ever-green ones. We cannot go on undermining soil fertility for short-term gain, draining wetlands for unsustainable prawn farms, mining forests, farmland and fisheries with little thought for tomorrow. We cannot expect to feed a fast growing population without addressing the underlying natural, social and economic systems which will affect everyone's ability to secure a livelihood.

That route, according to the considered view of the International Food Policy Research Institute (IFPRI), reported in this issue, can only lead to a more divided world, with even more malnourished children living in Africa and parts of South Asia 25 years from now. An alternative policy, with greater investment in agricultural research and measures to slow population growth would greatly reduce the numbers of hungry children. But it would also require stronger and better directed government investment in people, improved methods of food production, better use of water and pesticides and improvements in rural infrastructure. Unfortunately, as Jules Pretty points out, not one nation has yet produced an integrated policy for sustainable agriculture.

So perhaps the experts should stop arguing about just how many people we may be able to feed, and direct their attention to the new vision of a sustainable future which Gretchen Daily calls for, which IFPRI has attempted to outline and which Dr Swaminathan so eloquently sets out. As Margaret Catley-Carlson, President of the Population Council, has pointed out, there are investments which improve food production, income, family nutrition and health - and which help to slow population growth. They need to be pursued, urgently.

John Rowley

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NEWS FILE

This edition of Newsfile is devoted to a report by John Rowley on a three-day international conference in Washington on global food prospects for the year 2020, co-sponsored by the IFPRI and the National Geographic Society.

Forecasting the future

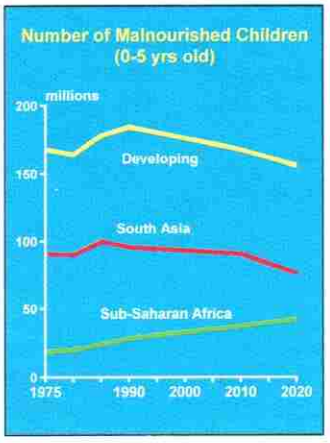
What chance is there that by 2020, with world population nudging 8 billion, everyone on earth will have access to a healthy diet, with efficient, sustainable, low cost agricultural systems that are in tune with the natural world?

That is the question which the Washington-based International Food Policy Research Institute (IFPRI) has been exploring since early 1994. Its work has involved scientists from 40 countries and the creation of a comprehensive projections model to look at various scenarios for the future.

To discuss their findings and recommendations, some 500 experts from over 50 countries gathered in Washington in June for a conference on A 2020 Vision for Food, Agriculture and the Environment. Highlights of the event are presented here.

Hungry Africa

While the world should be able to provide enough food to feed 8 billion people in the year 2020, with the main food crops selling at even lower prices than today, hundreds of millions will be hungry in the world's poor countries – unless there is a radical shift in policy trends.

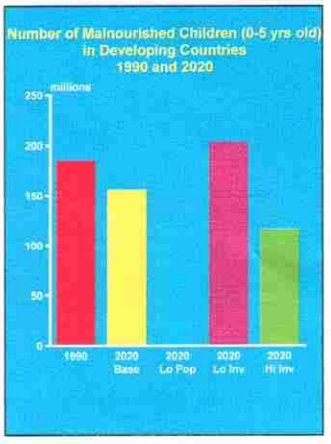


That is the central message which emerges from IFPRI's simulation model presented to the conference by one of its co-authors, Mark Rosegrant. This is based on data on 35 countries.

"This study shows that if projected trends continue, the world will have two distinct realities in the future," said Rosegrant. "Wealthy countries will have food surpluses, or the ability to import food at low prices, while poor countries will make little or no progress towards food security."

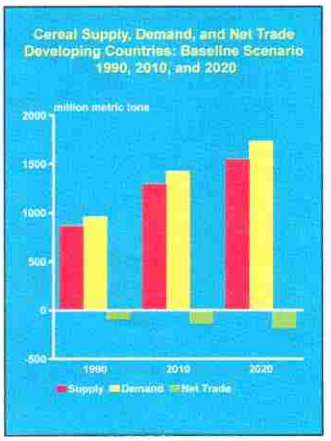
Hardest hit will be South Asia and especially Sub-Saharan Africa where food production will "barely outstrip expected population growth of 2.9 per cent a year."

"Declines in investment in agriculture, combined with the overwhelming challenges of



population growth, political unrest, urbanization, land degradation and water scarcity makes the future uncertain, at best. Our analysis shows that it is feasible to overcome these challenges, but only if farmers are backed by agricultural research."

In addition, there would have to be more investment in education and health, as well as general economic development to raise incomes, productivity and access to food, the study concludes. If there are to be dramatic reductions in child malnutrition, which now



IFPRI

affects nearly 200 million children, there would have to be equally dramatic reductions in poverty.

For countries dependent on agriculture this could only be done through a sharp increase in rural infrastructure, research and extension work coupled with broad-based economic development and increased social expenditures.

Specially damaging would be further reductions in developed country spending on agricultural research which has fallen over the past 15 years. If this continues, the study says that some 10 million children would be added to the ranks of the malnourished.

Scenarios of hope and despair

The IFPRI baseline survey throws up some fascinating forecasts. On world food prices it shows cereal prices falling by 20 per cent and meat prices by 10 per cent by 2020. It shows the developing world doubling its imports of food, with a tripling of import demand in Sub-Saharan Africa.

It indicates that child malnutrition, now affecting 184 million children will fall by only 29 million by 2020, mainly because of the huge population increases in South Asia and in Africa. Sub-Saharan Africa will actually see the number of malnourished children rising by some 14 million, as will

IFPRI

some South Asian countries, though there should be some improvement in India and Bangladesh as population growth rates fall there.

The biggest falls in child malnutrition are forecast in China (43 per cent), where wheat imports are expected to grow from 15 million tons to 28 million tons by 2020 (though see below), and meat consumption to rise by 3 per cent a year.

The charts on page 4 show some of the scenarios under various policy outcomes. These indicate that slowing population growth would have a major impact on food security and child malnutrition. Higher investments in agriculture would also have a big positive impact, leading to 76 million fewer malnourished children.

The best outcome would certainly result from policies which lowered population growth *and* increased investments in farming. This scenario is now being fed into the model.

Six-point plan

Presenting IFPRI's comprehensive plan to deal with the world food challenge, Director General, Per Pinstrup-Andersen, said the question was not whether we can feed the world. "Rather it is whether civil society and governments have the political will...to take the actions that are needed."

"Each day we wait, many thousands of children will die and many millions of people will be hungry, poor and desperate. Lack of action could lead to social and political instability...and a global refugee crisis."

Listing the main points for action he put first the need for stronger and better government, not less government. NGOs could not achieve the 2020 Vision alone. Developing country governments had to be strengthened to invest in people.

They had to step up agricultural production, with at least one per cent of developing country spending going into research into low-cost farming, rather than into high-cost subsidized methods used in the industrialized world. There had to be a special effort to improve farming in areas with fragile soils, limited rainfall and widespread poverty.

Water had to be used more efficiently and alternatives found to excessive use of pesticides (see below).

Finally, investment had to go into rural roads, electricity and telecommunications. Foreign aid for this and other aspects of the plan was crucial, and declines had to be reversed. "Time is running out," he concluded. "Already 1 billion people live on less than a dollar a day and 800 million people go to bed hungry...The 2020 Vision will not be achieved unless the productivity of poor people is increased and their access to employment enhanced."

Erosion hot spots

Spreading degradation of the land, through erosion, pollution and deforestation, is a potentially serious threat to food production and rural livelihoods, especially in more densely populated pockets of rural poverty, according to an IFPRI report.

This estimates that nearly 2 billion of the world's 8.7 billion hectares of cropland, pastures and forests used in agriculture have been degraded over the past 50 years. Globally, about 18 per cent of forest land, 21 per cent of pastures and 37 per cent of cropland is degraded. The worst forest damage is in Asia, while the greatest harm to crop and pasture land has been done in Africa.

The effects are not likely to affect global food security, since other areas of high productivity should be able to meet market needs, but the regional and local effects could be severe.

Among the damaged regions are northeast India, Bangladesh, Myanmar (Burma) and the humid lowlands of West Africa, where large areas of poor quality soils are being used too intensively.

The Green Revolution areas of Asia are suffering from waterlogging and nutrient imbalances, while continued salinization in the Indus, Tigris and Euphrates river basins in Asia could threaten regional supplies.

Other trouble spots include Central America, Indochina and the foothills of the Himalayas, where water erosion is a problem; the highlands of East Africa, the semi-arid border zones in Africa, the forest margins of the lower Amazon and peri-urban areas around large cities such as Mexico City where pollution could worsen.

The report says there are also bright spots where degradation is slowing down or being reversed. "Most types of degradation can potentially be reversed, but in most cases the process is long term" said Sara Scherr, an IFPRI research fellow. It was essential policy-makers urgently started to assess the most critical issues and encourage investment in land improvement.

Managing pests

A three-year study of farmers in the Andes region of South America has shown just how much destructive overuse of pesticides is taking place.

In a report to the conference, Cesar Cardona of the International Centre for Tropical Agriculture in Colombia, said many growers were bathing their beans in pesticides every 3 or 4 days, killing many natural predators, generating widespread resistance among damaging insects and poisoning their

Farmer spraying pesticides on a crop of dasheen, Dominica.

F. VIETA/FAO

crops. They were spraying other insects such as the greenhouse whitefly, which just did not justify spraying.

Bean farmers could reduce their use of pesticide by up to 70 per cent without lowering yields, by adopting integrated pest management (IPM) methods, he said. These encourage the use of

Greenhouse whitefly.

IFPRI

biological controls – often in the form of natural predators – with strategic and very sparing use of chemicals.

He said he hoped his report would influence the use of chemicals on other crops, which were equally overdosed.

Water wars

Water wars are almost certain to erupt unless action is taken swiftly to change wasteful water policies, an IFPRI report to the conference said.

Agriculture uses about 80 per cent of total water used in developing countries and is competing with the needs for residential and industrial purposes. The situation is made more dangerous because more than 200 bodies of water are shared by two or more countries.

A second study highlighted the situation in the Middle East where strife over water is erupting from the watersheds of the Nile to the Tigris and Euphrates rivers. Other crises are developing in South Asia where India, Nepal and Bangladesh are in dispute over the waters of the Ganges-Brahmaputra Basin, and in many of the major cities of the region.

According to the first IFPRI study by Rosegrant and Gazmuri, users often have little incentive to reduce their use of water owing to low pricing policies, and are doing ▶

immense damage through waterlogging as a result.

Proper pricing policies, as have been introduced in Chile, could go a long way to saving water and the environment, they say.

Chinese puzzle

There was a direct clash of opinion at the conference over China's likely import needs for cereals. While the IFPRI study said that imports were not likely to exceed a manageable 50 million tons by 2020, Lester Brown of the Worldwatch Institute repeated his fears that China's demand could be very much greater, putting great strain on world supplies and forcing up prices.

He pointed out that China would import 16 million tons of grain this year, while grain production was less this year than in 1990, not counting rice. There had already been a 60 per cent increase in price this year over last.

Interviewed later he pointed out that Japan had also experienced a steady decline in grain production following industrialization, and that the same thing was likely to occur in China, only on a much bigger scale – and with soaring demand.

But Jikun Huang, an IFPRI visiting research fellow, argues that "if China continues to invest in agricultural research, technology and infrastructure, there is no reason the country should drain the world food markets."

He argues that as China's population becomes more urban, city dwellers will eat less grain and demand more meat, dairy products and fish. As a result he believes per capita food grain consumption hit a high point in the late 1980s and should now fall as more people move to the cities.

The argument seems to have room to run.

AIDS impact

The main impact of AIDS on food security in Africa is likely to be through a reduction of economic productivity, says the IFPRI Vision 2020 study.

While AIDS may significantly reduce population growth rates, by as much as one-half in some African countries, the population size of most age groups in the region is expected to more than double by 2020.

However, because AIDS strikes down adults in their most productive years, it will reduce productivity. And as population growth outstrips economic performance, the world's poorest countries could grow even poorer in a cycle in which AIDS and malnutrition work together to undermine food security, the report says.

Genetic maps

Scientists working at Cornell University and China's Hunan Hybrid Rice Research Centre are using molecular maps and markers to harvest high-yielding plant genes from wild rice strains, which could boost Asian rice yields by 15–20 per cent, according to one researcher.

Susan McCouch, Assistant

Susan McCouch

Professor at Cornell's College of Agriculture and Life Sciences, told the meeting: "What we are doing turns plant breeding logic on its head." Just as two brown-eyed parents can both have a blue-eyed baby, two average-yielding crops can create a high-yielding plant. In both cases the offspring express genes that were hidden in the parents.

"With molecular maps and markers, we now have a kind of X-ray vision that can detect high-yielding genes and bring them together in varieties that will outperform any that exist today."

The only snag appears to be a shortage of research funds: Cornell is not anxious to take commercial funds that would see valuable seeds patented rather than made freely available to Third World farmers, she said.

Women farmers

Women were not very evident at the IFPRI Conference. But one who made up in impact for a shortage of numbers was Speciosa Wandira Kazibwe, Vice-President of Uganda.

"Unless you invest in women farmers you are wasting your time," she told the meeting. "Women are going to be the engines of change." To prove the point she said that in Uganda 80 per cent of food production was in the hands of women, women did 60 per cent of the planting, 70 per cent of the weeding, 60 per cent of the harvesting and 90 per cent of the food processing.

"Women must be helped to own land. Until they do we cannot expect them to improve productivity. They need credit, and they will repay it. We have discovered that in one typical project 88 per cent of the women had repaid their loan while not more than 40 of the men had done so."

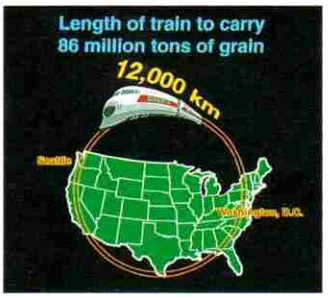
Population and food

Margaret Catley-Carlson, President of the Population Council, was the only population expert to address the conference. And she was the only speaker to remind the audience that feeding a world of 8 billion in 2020 was one thing: making sure that the following 25 years did not see another huge surge in numbers was another. And it needed action now.

"We have a choice of investments: some affecting demographic growth, some reproductive health, some soil health. But some – and these are the key – affect food production, family nutrition, income and population growth rates. These are the investments we must find."

Grain train

The 'grain gap' in West Africa and North Africa is likely to grow alarmingly according to Professor Adel El-Beltagy, Director-General of the International Centre for Agricultural Research in Dry



PETER MORENUS/CORNELL UNIVERSITY

Areas (ICARDA) in Aleppo, Syria.

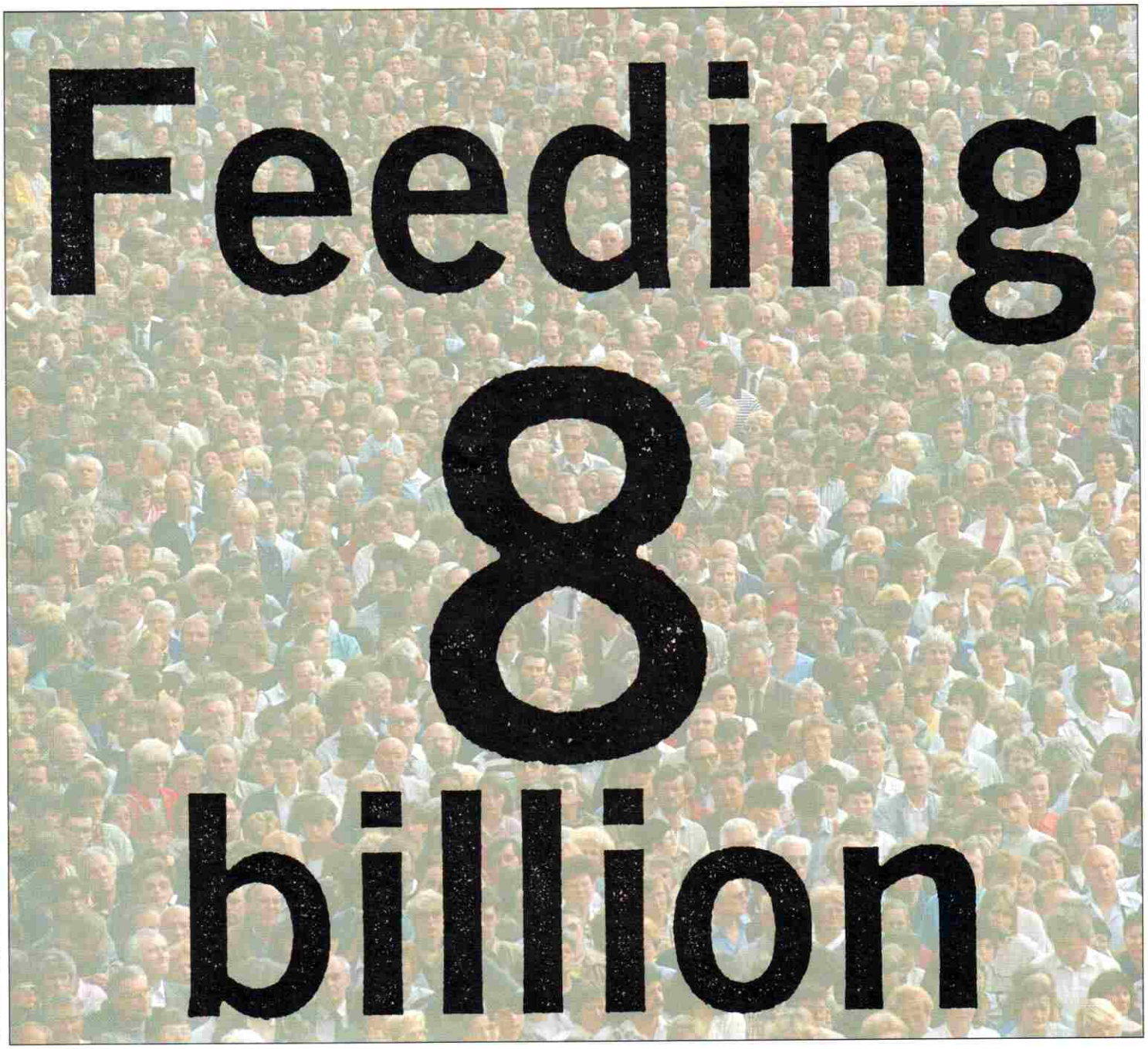
Excluding Turkey, the deficit between grain production and demand in the 14 WANA countries is likely to grow from 33 million tons in 1990 to 86 million tons a year by 2020. To express this vast amount he showed a slide of a 12,000 km train loaded with grain (see above).

Passion

Last word must go to Ismail Serageldin, Vice-President, Environmental Sustainable Development, of the World Bank. What was missing from the meeting, he said, was "passion".

"If anything is going to happen, we need to communicate that this is a matter of life and death – nothing less than the liberation of our fellow human beings from poverty and hunger."

■ *Reporting on the conference was made possible by a generous grant from The Simon Population Trust, UK. For more information on the 2020 Vision study contact: IFPRI, 1200 Seventeenth Street NW, Washington DC 20036-3006, USA. Fax: 1-202 467 4439.*



LIBA TAYLOR/PANOS PICTURES

Can tomorrow's world feed itself?
John Madeley introduces our Great Debate

There are few more searching and important questions than – "will the earth yield enough food for the people who will be alive in the 21st century?"

Agriculturalists, among others, face the problem of not knowing how many people to expect at the world dinner table. Do they plan on the basis of estimates such as a Winrock International study which expects zero population growth by 2035 – with population at about 7.8 billion – and a decrease in numbers throughout the rest of the century? Or do they plan to feed 12.5 billion people by 2050, in line with the "high variant" estimate in *The State of World Population 1994* report?

What we do know is that by the year 2020 the global population is likely to be around 8 to 8.5 billion. This means that the world will have 2.5 billion more people to feed than in 1995, when some 800 million do not have enough food to live a healthy and productive life. Can it be done?

The UN Food and Agriculture Organization (FAO), in a major study *Agriculture: Toward 2010*, (published in late 1993), expects global food output to rise by 1.8 per cent a year in the next 20 years, compared with 2.3 per cent a year in the last 20 years. While the FAO expects a lower growth of food output, it believes this will outpace population growth, which it estimates is likely to slow down from 1.7 per cent to 1.3 per cent a year.

The study predicts that by 2010, the daily per capita food supplies available to people in East Asia, the Near-East, North Africa, Latin America and the

Caribbean will increase from 2,500 today "to at or above the 3,000 calorie mark". It expects South Asia to make progress, with the percentage of chronically undernourished people halving to around 12 per cent of populations.

But little progress can be expected in sub-Saharan Africa, it seems. By 2010, the African continent may have 300 million undernourished people, 32 per cent of its population, against 180 million today. Worldwide, around 650 million people are likely to be undernourished in 2010, predicts the study, compared with 800 million today.

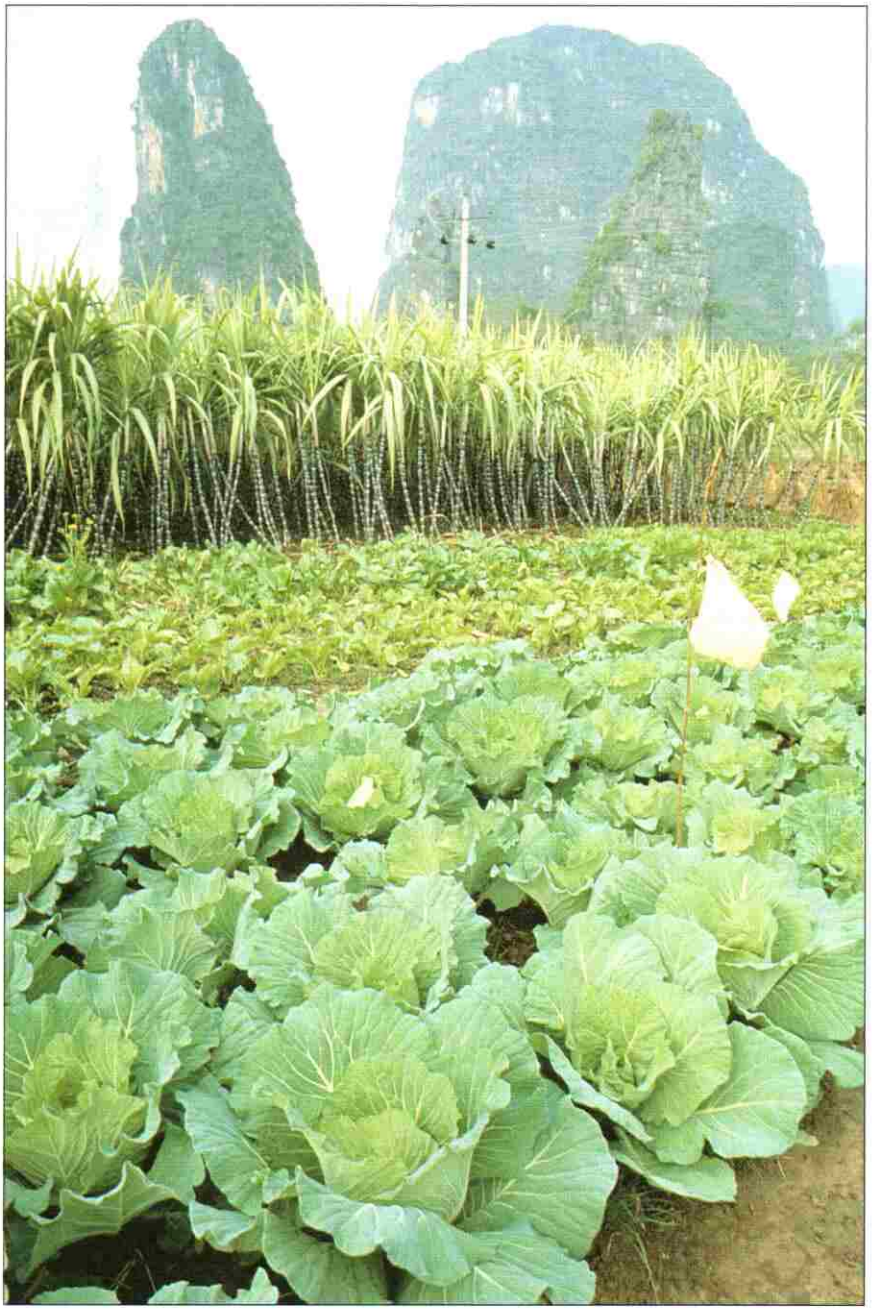
So according to the FAO, the world will not be able to feed 650 million people adequately in 2010 – a slight improvement on today perhaps, but still a humanitarian scandal.

And the FAO study is at the optimistic end of the scale. Lester Brown and Hal Kane, in *Full House: Reassessing the Earth's Population Carrying Capacity*, published last year, take the view that constraints are emerging that make it difficult to expand food output. They point, for example, to the substantial loss of cropland to industrialization and urbanization, to the stagnation of global fish catches, and to the way that demands for water are pressing against hydrological limits.

Apart from environmental pressures, Brown and Kane also say that declining investment in agricultural research is not helping. They conclude that the world is close to its carrying capacity, and believe that the imbalance between food and people should be addressed by a frontal attack on population growth.

The "optimists" would generally agree that environmental pressures are serious and that more should be spent on agricultural research, not least to ensure that increases in food output can be sustained. Many current agricultural practices are notoriously unsustainable. Monocropping, for example – the practice of growing a single crop on large fields – can be highly damaging to soil. The FAO says that the world is losing 7 million hectares of cultivated land a year due to soil degradation, and that in the next 20 years, 140 million hectares (an area larger than Italy) could lose much of its agricultural value.

Yet agriculture has no need to mine the soil. Intercropping – growing two or more crops together – supports rather than mines the soil. In China, where intercropping is widespread, food output is growing at 2.8 per cent a year, twice the rate of population growth.



SEAN SPRAGUE/PANOS PICTURES

In practice, the optimists and the pessimists have much in common. Both are playing a numbers game, looking at the past and extrapolating the future in different ways. The optimist recognizes the constraints, but plays them down, the pessimist sees them as more serious. It is possible, however, that both are insufficiently grounded in what is happening in communities across the Third World, and place too little emphasis on what people can achieve.

The hope of overcoming hunger and famine is for the numbers game to give way to the people game.

Across the developing world today, people are taking initiatives and developing ways of growing more food. And the potential is enormous. Policymakers need to consider what might happen if the energies of small-scale farmers are released and they have access to the credit and the technology they need. What might happen if methods such as permaculture take hold? If women producers get the policies they need? What happens if rural economies are stimulated so that people have more money to buy food, so encouraging farmers to grow more? Can people confound the experts?

"Depressing trends, hopeful possibilities," is how Vaclav Smil sums up the links between population and food. The possibilities are not only considerable – for many small-scale farmers in developing countries they are practical reality.

One of the main hopes for increasing and sustaining food output is permaculture (permanent agriculture). Under this system, farmers use no inputs, such as chemicals, from outside the area

SEAN SPRAGUE/PANOS PICTURES

S PINTUS/FAO

Far left: *Intercropping is a popular farming method in China. Here cabbages and sugar-cane are grown together.*
Above: *A crop research station in Burkina Faso – funding for such stations is being cut.*
Left: *Drought resistant cassava is a focus of research in Africa.*

where they farm. They grow a mixture of food and tree crops, and often keep small livestock, with each part of the system benefiting the other parts.

There are few mentions of permaculture in government statements on agriculture. Yet, this people-driven farming method is suitable for both rural and urban areas. With around 4 billion people expected to live in urban areas by 2020, permaculture could be vital in helping people to grow food intensively in small plots (see page 21).

Women grow most of the food in developing countries, but women farmers are often ignored by governments. They usually cannot obtain credit from the banks to buy the equipment and inputs they need, they often cannot own land and have no incentive to improve the land they farm.

Credit schemes are enabling small-scale farmers in many developing countries to invest in their farms, and are proving one of the most successful ways of increasing food output. Schemes like the Grameen (village) Bank in Bangladesh are raising standards of living in villages by lending to the landless, mostly to women. This in turn helps farmers – when rural dwellers have more money in their pockets farmers have more incentive to step up food output.

People-led initiatives to grow more food can undoubtedly benefit from constructive support from governments. Many of the policies needed for lower fertility rates would also help women to increase their food output. Empowering women and guarding their reproductive health should not only give women more say over how many children they have, it might also make it more likely they qualify for credit from the banks. In addition to credit schemes, changes to land tenure laws are encouraging higher and more sustainable food output.

Technology has a key role to play in ensuring the growth and sustainability of food output, provided it is people-scale. Low-cost technologies that are both affordable and environmentally sound are already making a significant contribution. Integrated pest management, for example, is now more widely used in developing countries, enabling farmers to control crop pests more cheaply and without chemicals that can damage the environment.

The carrying capacity of productive lands can be increased through environmentally sustainable agricultural technologies, stresses Peter Hazell of the International Food Policy Research Institute (see Newsfile).

Jules Pretty of the International Institute for Environment and Development describes resource conserving technologies, local groups and institutions and the genuine participation of local people as "the three common elements of success" for sustainable agriculture (see page 20).

Scientific research can do much to support people-led initiatives. All developing countries have agricultural research programmes but many are constrained by lack of funds and trained staff. National programmes are complemented by an international network of 16 research stations, funded by donors such as Western governments, belonging to the Consultative Group on International Agricultural Research (CGIAR). The stations have a mandate to research the basic food crops that are vital to the poor. Many of the scientific breakthroughs of the past 30 years have come from work done by their researchers, often in collaboration with national institutions.

Food output is increasing as a result. Research at the Ibadan, Nigeria-based International Institute of Tropical Agriculture, for example, has led to the development of improved cassava varieties and helped Nigeria to increase its output of the crop by 50 per cent between 1992 and 1994. But funding for the stations has been cut back in the last three years, which is not helping the world to grow more food. Research is a key link in the task of increasing food output in sustainable ways. "If you do not invest in research you will not be able to solve problems in the future," points out CGIAR chairman, Ismail Serageldin.

Internationally, there also remains the irony that the world has enough food for everyone, but that too much is grown where it is not needed. While millions go hungry, the barns of Western countries overflow with surpluses.

"We could improve the distribution of existing food supplies so that we don't have food surpluses in one part of the world and people starving in another," says Elizabeth Dowdeswell of the United Nations Environment Programme. The problem is how to do it.

If people-led initiatives around the world are recognized and supported, then there is hope for the next century. Sustainable farming may then look like a mess, perhaps, to the outsider – a complex mix of food and tree crops on small plots of land developed by people in ways that suit them, where productivity is high and yields can be maintained. The hope is with people. ■

John Madeley is editor of International Agricultural Development *magazine.*

1. *How Many People Can the Earth Feed?* Population and Development Review 20 No. 2 (June 1994).

Must the poor starve?

MARK EDWARDS/STILL PICTURES

Our Great Debate on feeding 8 billion people by 2020 opens with a warning from *David and Marcia Pimentel* of the College of Agriculture and Life Sciences at Cornell University, that we may be facing the prospect of millions more malnourished people.

CHARLES HARRINGTON/CORNELL UNIVERSITY

As the human population continues to grow in a geometrical way, while food production grows arithmetically on our finite planet, it is becoming increasingly difficult to ensure that food production will meet escalating human needs.

According to the World Bank and the United Nations more than one billion humans are now considered malnourished, indicating a combination of insufficient food and inadequate distribution. This is the largest number of hungry humans ever recorded in history. With the world population projected to double from about 6 billion to more than 12 billion in about 50 years, based on current rates of increase, many scientists believe the world food problem will become increasingly severe, conceivably with the numbers of malnourished reaching 3 to 4 billion.

Based on their evaluations of available natural resources, scientists of the Royal Society and the US National Academy of Sciences have issued a joint statement reinforcing the concern about the growing imbalance between human numbers and the resources that support them.

Reports from the Food and Agricultural Organization, numerous other international organizations and scientists confirm the existence of this serious food problem. For example, the per capita availability of world grains, that makes up 80 per cent of the world's food, has been declining for the past 14 years. Certainly with a quarter million people being added to the world population each day, the need for food increases.

More than 99 per cent of the world's food supply comes from the land, while less than 1 per cent is from oceans and other aquatic habitats. The continued production of an adequate food supply is directly dependent on an ample supply of fertile land, fresh water, energy (especially fossil energy), and the protection of biodiversity. As the human population grows, the requirements for these resources also grows. Even if the total resources are not depleted, resources on a per capita basis will decline as they are divided among more and more people.

Fertile cropland, is being lost at an alarming rate. For instance, as the World Resources Institute has pointed out, nearly one-third of the world's cropland (1.5 billion hectares) has been abandoned during the past 40 years as erosion has made it unproductive. Erosion is a long-term problem because it takes 500 years to form 2.5 cm of soil under agricultural condition.

Most replacement of eroded farm land comes from marginal land, generally cleared forests. Indeed, agriculture accounts for 80 per cent of the world's deforestation. Despite such land

Far left: *Intensive farming, Perth, Australia. For every pound of bread produced in Australia seven pounds of topsoil are lost forever.*
Left: *Bee pollinating. No technology can substitute for this free service.*

Below: *Massive amounts of water are used to irrigate cropland in California.*

GRAHAM BURNS/ENVIRONMENTAL PICTURE LIBRARY
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replacement strategies, world cropland per capita has been declining and is now only 0.27 ha per capita. This is nearly one-half the 0.5 ha per capita, which is considered minimal for a diverse diet of animal and plant products. The shortage of productive cropland, plus decreasing land productivity is, in part, the cause of current food shortages and associated human malnutrition. Other factors, such as political unrest and unequal food distribution patterns also contribute to shortages.

All crops require and transpire massive amounts of water during the growing season. For example, a hectare of corn that produces about 7,000 kg of grain will transpire more than 4 million litres of water during the growing season. In total, agricultural production consumes more fresh water than any other human activity. Worldwide, about 87 per cent of the fresh water is consumed by agriculture and this is not recoverable. To supply this much water to a crop requires from 6 to 8 million litres of water per hectare.

A major threat to maintaining fresh water supplies is the continuing overdraft of our surface and ground water resources. Water resources, critical for irrigation, are under great stress as more populous cities, states and countries need and withdraw more water from rivers, lakes, and aquifers every year. At present, 40 per cent of the world's people live in regions that directly compete for water. A reflection of these water shortages is the per capita decline in irrigation used for food production in all regions of the world.

Nearly 80 per cent of the world's fossil energy is used by the developed countries to maintain their high standard of living. The intensive farming technologies of developed countries use massive amounts of fossil fuel for fertilizers, pesticides, irrigation, and machines as a substitute for human labour. In developing countries, by contrast, the use of energy has been primarily for fertilizers and irrigation to help prevent starvation rather than reduce labour inputs. However, fossil energy is a finite resource and its depletion is being speeded up as population needs for food and services escalate.

The United States is now importing 60 per cent of its oil and expects to exhaust all of its oil reserves in 15 to 20 years. Then oil imports will have to increase and the US trade imbalance will be further skewed. As supplies of fossil energy dwindle, the cost of fuel everywhere increases. This is already becoming a serious problem for developing countries, where the high price of imported oil making it less affordable for the poor farmers. Therefore, less will be available to power irrigation and provide for other agricultural needs in developing countries. Worldwide, per capita supplies of fossil energy already have started to decline.

Economic analyses often overlook the biological and physical constraints imposed on food production. The assumption is that market mechanisms and international trade are effective insurances against future food shortages. A rich economy is expected to guarantee an adequate food supply to meet a country's demand despite existing local ecological constraints. However, when global biological and physical limits to domestic food production are reached, food importation is no longer a viable option for any country. At that point, food importation for the rich can only be sustained by starvation of the powerless poor.

These concerns about the future are supported by two observations. *First*, most of the 183 nations of the world are now to some extent dependent on food imports. Most of these imports are cereal surpluses produced in only a few countries that have relatively low population densities and practice intensive agriculture. For instance, the United States, Canada, Australia, Oceania, and Argentina provide 81 per cent of net cereal exports on the world market. If as projected, the United States population doubles in about 60 years, based on the current rate of increase of 1.1 per cent, the United States would cease to be a net food exporting country. Then all food resources would have to used to feed the 520 million hungry Americans.

In the future, as exporting nations will need to keep surpluses at home, Egypt, Jordan as well as countless other countries in Africa and Asia will be without the food imports that now help them survive. China illustrates this problem. China now imports many tons of food, but if their population increases by 500 million, and soil erosion con-

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MARK EDWARDS/STILL PICTURES

Above: *Spraying pesticides onto fruit trees in the Po Delta, Italy. Over seven tonnes of pesticides are washed into the Po every year.*

tinues unabated, by 2050 or so they may need to import 200-400 million tons of food, as Lester Brown of the Worldwatch Institute has recently pointed out. But by then, the food may not be available.

Second, all developing countries are coming to rely more heavily on fossil energy, especially for fertilizers and irrigation, to sustain their food supply. The current decline in per capita use of fossil energy, caused by the decline in oil supplies and their relatively high prices is generating direct competition between energy use in developed and developing countries.

Certainly technology will assist in improved management and more effective use of various resources, but it cannot produce an unlimited flow of those vital natural resources that are the raw materials for sustained agricultural production. For instance, fertilizers can enhance soil fertility, but humans can not make topsoil. Indeed, fertilizers made from finite fossil fuels are being used to compensate for erosion. And although increasing the size and speed of fishing vessels has enabled us to overfish the oceans and lakes, it has not increased the per capita fish catch. Overfishing is so severe in regions like eastern Canada, that cod fishermen are now on shore and destitute.

Consider also the supplies of fresh water. Water withdrawn from the Colorado River by several states for irrigation and other purposes results in the river being nearly dry by the time it reaches Mexico. There is no technology available that will double the flow of the Colorado River. Similarly, shrinking ground water aquifers cannot be refilled by human technology.

In addition, agricultural production depends on the integrity of biodiversity to maintain food production. In New York State on one bright, sunny day in July, the wild and other bees pollinate an estimated 1,000,000 million blossoms of essential fruits and vegetables. Humans have no technology to substitute for this vast task or the numerous other services provided by natural biodiversity.

Considered strategies for the future, must be based, first and foremost, on the conservation and careful management of land, water, energy, and biological resources for food production. Once these resources are exhausted they can not be remade by humans. In addition, more efficient and environmentally sound agricultural technologies must be developed and put into practice to support the continued productivity of agriculture.

Yet none of these measures will be sufficient to ensure adequate food supplies unless the growth in the human population is curtailed. Before we are confronted with more food shortages and resource crises, we need to change our stewardship of the world and balance human numbers with land, water, and other resources. ■

David Pimentel is Professor of Ecology and Agricultural Sciences at Cornell University. Marcia Pimentel is Senior Lecturer in the Division of Nutritional Sciences at Cornell University with a particular interest in the impact of food shortages on the world problem of malnourishment.

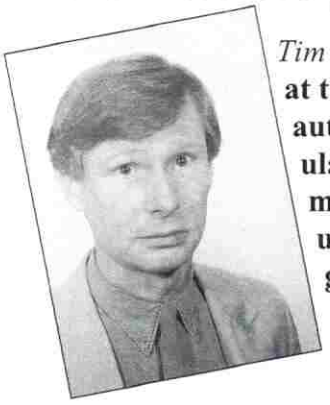
Few of us can be satisfied by the current world food situation. It is hard to talk in precise numbers, but there is no doubt that, today, several hundred million people – mostly in South Asia and sub-Saharan Africa – do not have reasonably assured access to adequate supplies of food. In common parlance, these people are hungry. And, invariably, they are poor.

There is also no doubt that population growth (rather than improvements in living standards) is the chief reason why more food is now being grown and consumed. Rough indications are that since the Second World War at least two-thirds of the increase in world cereal production (cereals being the main form of human food) can be attributed directly to population growth. Moreover, this fraction is rising. Looking, say, at the period to the year 2020, demographic growth will probably account for at least 80-90 per cent of the total increase in global food demand.

So, population growth is laying down the principal challenge to the world's farmers. And if populations were to grow more slowly during the next few decades this would certainly ease the task of raising levels of per capita food supply. This said, several misunderstandings about recent trends have often led to an alarmist and overly-pessimistic view of the world's immediate food prospects.

First, it is important to acknowledge that, taking the world as a whole, considerable progress has been made during recent decades. For example, in the 1950s world per capita cereal production was around 300 kg. In the 1980s the figure has been around 350 kg. Similarly, famines have generally decreased in size and frequency. The food crisis in China in the years around 1960 was partly due to harvest failure; it may have involved between 16 and 30 million excess deaths. But the so-called 'world food crisis' of 1972-74 certainly entailed many fewer deaths. And the famines in sub-Saharan Africa (notably Ethiopia) around 1983-84 probably caused fewer deaths still. The phenomenon of major famine – usually

Be wary of the gloom



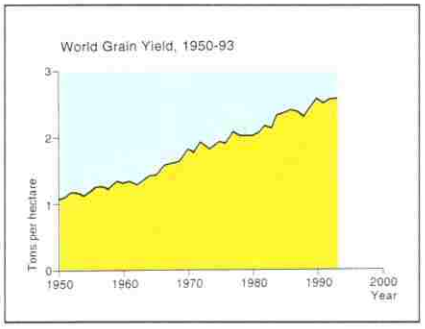
Tim Dyson, **Professor of Population studies at the London School of Economics and author of a forthcoming study on population and food, points to six common misunderstandings on the subject and urges readers to be wary of too much gloom.**

triggered by a combination of warfare and drought – has become largely confined to sub-Saharan Africa. This is no reason for satisfaction. But the fact of some progress deserves recognition.

Second, while the world's population has been growing faster than cereal production since the early 1980s (leading to a decline in world per capita grain output) it is important to appreciate that this has been caused by factors which are largely unconnected with rapid population growth. Essentially, the explanation is that during the last decade both the United States and the European Union have been producing more cereals than they have been able to sell – even at heavily subsidized prices. The same has been true of smaller producers like Canada, Australia and Argentina. Consequently, large areas of cereal cropland have either been taken out of cultivation altogether (i.e.'set-aside' or 'idled') or switched to other food crops. Farmers in all these major grain-growing regions have had little incentive to cultivate cereals. This is the main reason why the world's population has been growing faster than its cereal output.

Third, so far as can be determined, the world's production of food in general has been keeping slightly ahead of population growth during recent years. Of course, food is a much more varied category than just cereals. To capture this, the FAO has devised an index of per capita food production. This weights together all the main types of food. The index fluctuates somewhat from year to year. But it is invariably higher than 100 – signifying generally faster growth of food than of population. In this context there is good evidence that since the early 1980s much of the land which has been withdrawn from cereal cultivation has been converted to the production of other higher-value foods. And in most world regions diets are becoming more diverse.

Fourth, the world's most populous developing countries have performed



SOURCE: BROWN AND KANE

quite favourably in keeping their food output ahead of their demographic growth. With a fifth of humanity, China has done especially well since the late 1970s. There is indisputable evidence that the Chinese diet is now much improved. The explanation for this involves things like China's agricultural reforms, and the development and rapid introduction of hybrid rice. India too has probably experienced greater improvements in per capita food output since the early 1980s than in any previous period. This is not to deny that both countries – especially India – still contain many hungry people. But, nevertheless, these achievements deserve some notice.

Of the world's major regions, only in sub-Saharan Africa are there clear signs that agricultural systems have generally been unable to keep food production up with population growth. This region's agricultural problems are numerous and complex. That many African countries are ethnically diverse, have fragile infrastructures and weak administrative systems, are all very relevant factors. However, many agricultural experts in the region are firmly (and rightly) of the opinion that rapid population growth is one serious impediment to improving the long-run food situation there.

Fifth, there is no reason to be particularly alarmed by recent trends in world cereal yields. Lester Brown and Hal Kane, have recently claimed that there has been a 'dramatic slowdown' in the pace of world grain yield growth[1]. If true, this would indeed be important because of the central place of cereals in the human diet. However, the graph below shows that world cereal yields have actually been marching upwards at a pretty constant linear rate – corresponding to a gain of about 45 kg per hectare per year. The only way in which this fairly steady upward trend can be depicted as a 'slowdown' is if the increase is gauged in percentage terms. But the graph shows, quite clearly, that a linear representation is much more appropriate. Of course, there are places where yields are flat or in trouble. But, equally, there are many other places where yields are rising fairly strongly.

Sixth, and somewhat paradoxically, the average level of world per capita food (or cereal) consumption (or production) is actually a rather poor guide as to trends in global food availability. For example, it is easy to demonstrate that even if the level of per capita food consumption were to rise in all the major world regions during the next few decades, the level of average world per capita food consumption would probably still decline. The explanation, of course, is that future world population growth will mostly occur in the developing regions – which also tend to be much more poorly fed. So even if levels of food consumption improve in these regions, the fact that they are steadily becoming a higher fraction of

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humanity (due to their faster rates of population growth) will tend to weight downwards the average level of world food consumption per head.

Finally, some brief speculations regarding the future. In the early 1990s about 700 million hectares of cropland worldwide is being harvested of cereals each year. Provided the upward linear march of yields shown in the graph continues to the year 2020, and with only a modest expansion of global harvested area, this should be sufficient to satisfy any likely increase in world cereal demand over that period.

This said, it seems inevitable that – with the possible exception of Latin America – most of the world's developing regions are going to become significantly more dependent upon supplies of cereals from outside. Their

Left: *High-yielding wheat in India. World cereal yields have shown a steady upward trend.*
Below right: *Solar panels are used for energy in Sudan.*

collective demand for imports will greatly increase – and it will be met by increased cereal production in North America, Europe (including Eastern Europe, Ukraine, and parts of Russia), Australia, Argentina, and perhaps a few other countries such as Brazil. Most developing regions should be able to finance these imports. But this may not be true in sub-Saharan Africa – which is the region facing the sharpest rise in food demand due to demographic growth. Sub-Saharan Africa's food prospects seem uniquely bleak.

For sure, realizing this general increase in global food output in the period to 2020 will not be easy (it has not been easy in the past). And it would probably be impossible without greatly increased output of synthetic nitrogen (fertilizer). Certainly, some world regions face major problems of water scarcity for agriculture. The demographically-driven need to raise food production will cause environmental damage in many parts of the world. Over the longer run, it is hard to be confident of the eventual agricultural consequences of global warming (and other forms of human folly). Moreover, in 2020 many populations in sub-Saharan Africa will still be growing very fast. I would like to add one hundred other caveats.

But, nevertheless, you the reader, should be very wary of accepting much of the gloom. Sometimes, seemingly straightforward claims require much closer scrutiny. Looking forward 25 years, there is a reasonable expectation that the world food situation will be no worse – and may indeed be somewhat better – than it is today. ■

1. Brown, L.R. and Kane, H.(1995) *Full House: Reassessing the Earth's Population Carrying Capacity*, London: Earthscan and W W Norton.

The research on which the present article is based was undertaken under a Research Fellowship from the Global Environmental Change Programme of the UK Economic and Social Research Council. The research will form the basis of the book, Population and Food: Global Trends and Prospects, *to be published early next year.*

HARTMUT SCHWARZBACH/STILL PICTURES

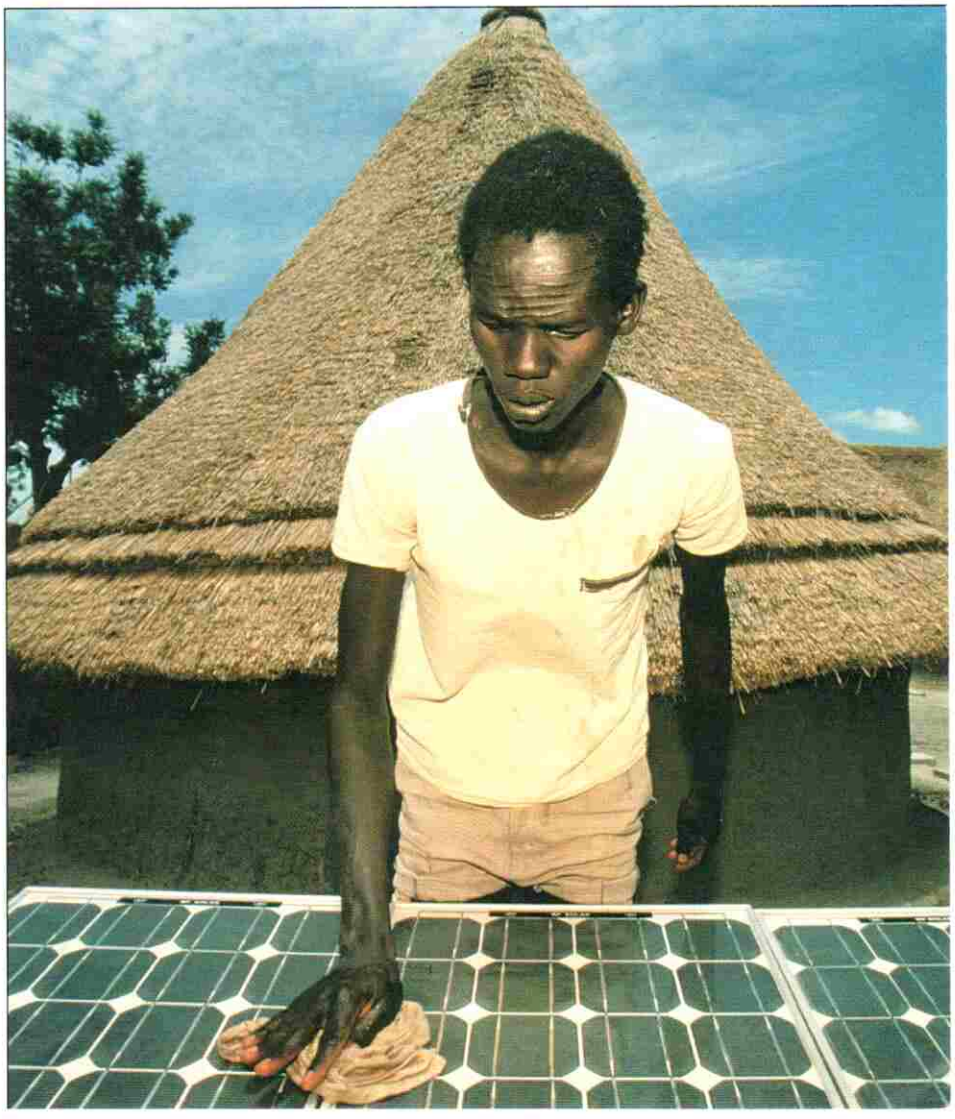
Providing energy and food for all

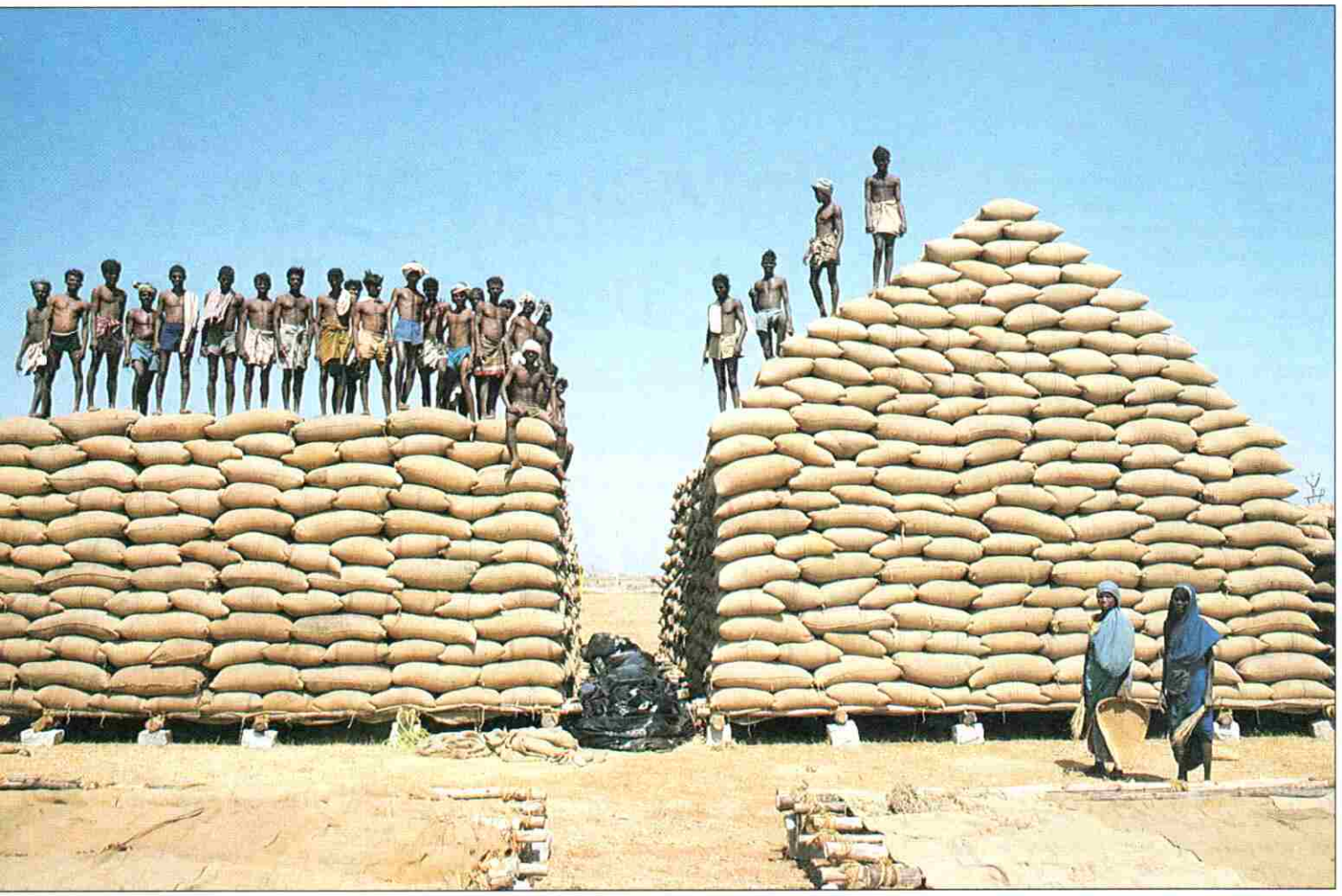
The real opportunities for feeding a world of 8 billion in a sustainable and equitable way have been drowned out by the predictions of doom, says plant biologist *David Hall* **of King's College, London.**

'It is very easy to provide food – all you need to do is to sprinkle money on farmers'. This apocryphal quotation captures my feelings clearly. Given the correct incentives and infrastructure, farmers and the land can be productive and provide adequate amounts of food in a sustainable way.

In order to grow food, farmers need security of tenure and income, combined with extension services and research; but these factors are often lacking in many parts of the world, especially where food shortages exist. If farmers produce the food in adequate amounts, the local and national distribution required to ensure access and equitable per capita availability depends on political and economic policies.

This, of course, is all well known.





RON GILLING/PANOS PICTURES

But how does it relate to the question often posed about shortages of food for so many of the world's people? Populations cannot go on forever increasing and some stabilization is essential – but when will this happen and how?

President John F Kennedy said in 1963, "We have the ability, as members of the human race, we have the means, we have the capacity to eliminate hunger from the face of the earth in our lifetime. We need only the will".

If we thought we could do it over 30 years ago, why do we spread doom and gloom now when cereal production per capita has increased by 23 per cent in the last 40 years. We certainly appear able to provide food (and also the fuel needed for agriculture and increased quality of life) over the next 50 years until world population stabilizes. The problem is more making the global abundance available to those who are disadvantaged – thought to be about one billion, or about a fifth of the world's population.

Energy in all its forms (animal, human, fossil, renewable and nuclear) is the driving force which ensures productive agriculture, development, and increased standards of living. Presently, two-thirds of the world's energy is consumed by the quarter of the world's people who live in developed countries, while three-quarters of the world depends on biomass as their main energy source (38 per cent of all energy used in developing countries).

The problem with fuel use today is the pollution caused by the inefficient and/or excessive use of energy and the over-dependence on traditional forms of biomass. These problems can, however, be overcome given the well-documented scenarios incorporating clean energy technologies and the provision of modern energy services to all those who need them. Indeed, a recent Shell study predicts that "new energy sources may well become commercially competitive over the next decades" and after about 2030 such energies will provide all the incremental energy requirements. There is no shortage of energy but rather the inability of the environment to continue to absorb the pollution caused by present-day energy use patterns.

Detailed energy studies done for the UNCED Conference in Rio in 1992 and the nearly completed analyses by the International Panel on Climate Change, show that provision of energy for sustainable development is certainly possible and can be done in an environmentally acceptable way. Of course, there are concerns about increasing coal use in, for example, China and India, but the solutions are available to use clean energy technologies if they were made available in economically competitive forms. The concern for the increasing requirements for polluting transport fuels can be met by using, for example, fuel cells running on renewably-produced fuels such as methanol and hydrogen.

India is also an example of changing trends in food, energy, population and environment. Who would have thought that 15 years ago India would virtually halt deforestation and increase its tree-crown cover? A combination of remote sensing ground truthing has established this. Currently India is sitting on a stock pile of 30 million tonnes (Mt) of grain, of which about 5 Mt is stored in the open under plastic sheets because of lack of storage and export facilities; this pile may further increase by 6 Mt very soon with new harvests. Agricultural production as a whole has continued to rise at near constant rates even though the cultivated area has remained static for some time.

Modernized biomass energy could provide electricity, gas and transport fuels for three-quarters of India's population who live in rural areas, thereby

Left: *Part of India's grain mountain of 30 million tonnes.*
Right: *Preparing specimen rice plants for a laboratory test. Indonesia.*
Below: *Irrigating rice with a shadoof, Bangladesh.*

J M MICAUD/FAO

S B G MCCULLAGH/HOLT STUDIOS

fuelling development while providing many ancillary social and environmental benefits. Land availability is therefore, not a constraint even in a densely populated country such as India. The population growth rate of India has declined slightly over the last two decades (to 2.1 per cent per year) but we have the example of two states in South India (Tamil Nadu and Kerala) where near zero population increases prevail due to well-recognized social and development reasons, of which literacy and opportunities for women appear so important.

Of course, there are severe problems of poverty, malnutrition, environmental degradation and urban squalor in India, but overall India's standard of living is heading constantly upwards. Can this then be accelerated so that India one day finds itself in the same situation as some other Asian nations, such as Japan, South Korea and Thailand, where fertility levels are below replacement levels and a cause for concern?

How many people can the world provide food for? Estimates have varied widely from 2 to 40 billion with a number of studies now focusing on the 10 billion figure predicted for the 'medium projection' by the UN for 2050. Many statistics can be marshalled to support optimism or pessimism, but this author is impressed by the inexorable increase in global plant productivities of the last 50 years (about 2 per cent per year) and the increased per capita food availability in all regions, except for Sub-Saharan Africa. Here there is cause for hope given the vast, potentially fertile land availabilities if they could be coupled with incentives for farmers and fewer political upheavals.

In 1975 Buringh showed that with given plant growth conditions in various soil regions of the world and the application of modern farming techniques, that global grain production could be increased thirty-fold[1]. This is highly unlikely to happen, but it emphasizes a constant theme that agricultural producers need the appropriate incentives and infrastructures, along with conducive social structures, if they are to achieve higher average yields than at present.

We have examples in Europe and the United States where average wheat and maize yields have increased 3-4 fold over the last 50 years and the main problems of agriculture are excess food and land. In Asia wheat yields have increased five fold and rice yields doubled over the last 30 years. Yield predictions made for maize and wheat in the 1970s have been far surpassed 20 years on in farmers' fields.

Estimated physical limits for maize grain production have been calculated at 22 tons per hectare (t/ha) at 40 degrees latitude; recently 21 t/ha was achieved in a Washington State farm, and this is five times the world average. A recent Dutch study predicted that the 12 EU countries might have about 40 million hectares (Mha) of surplus agricultural land in the next century, or one-third of the present total[2]. This is without even considering the effects on Western Europe of modernizing agriculture in Eastern Europe and the Former Soviet Union.

The yield increases required to feed 10 billion people can only be achieved if agricultural research and extension are well funded and locally available in order to complement the other requirements such as credit, education and health care in rural areas. Successful examples of such combined circumstances exist in, for example, the Machakos District in Kenya where in the 1930s irreversible degradation was predicted. It seems perverse, however, that during the 1980s agriculture's share of development assistance fell to only 14 per cent (from more than 20 per cent) while the total budget for the International Agricultural Research Centres (CGIAR) is only $300 million per year or 0.5 per cent of developed country aid.

If food production is intensified (the energy and technologies are available) will the increased grain production be used for meat production rather than producing cereals for the undernourished? This may be likely but is not necessary. If chicken meat is consumed instead of beef, this results in a very sharp drop in the grain feed requirement. (About 2.6 kg of maize is required per kg of chicken meat as against 13 kg in the case of beef). In the United States a shift from predominant red meat consumption to a combination of red meat and poultry has resulted in a 'freeing up' of about 16 Mha of land.

Much of what is written above is well known but drowned out the predictors of doom. It is time that the real opportunities for providing fuel and food in a sustainable and equitable way were more widely appreciated *and* acted upon. ■

1. Buringh, P. (1987) *Food production potential of the world.* Population Development Review 5.
2. Waggoner, P. E. (1994) *How much land ten billion people spare for Nature?* Report 121, Council for Agricultural Strategy, Ames, Iowa.

Professor David is Hall is a plant biologist trained in agriculture. He has research collaboration with, and teaches training courses in, over 20 developing countries. A major interest is biomass energy and the 'food versus fuel' debate. His latest book Biomass, Energy, and the Environment, *(with Dr N H Ravindranath) is published by Oxford University Press (£60.00).*

Foreclosing the future

Feeding a world of 8 billion could be a triumph or a disaster, argues *Gretchen Daily*. Casting the debate simply in terms of whether or not it could be done obscures important measures by which success should be judged.

The world in 2020 hinges upon sustaining the essential natural underpinnings of agricultural productivity because their loss would be, in many instances, completely irreversible on a time scale of relevance to humanity. Providing immediate food security for the human population when it first reaches 8 billion would constitute a Pyrrhic victory at best if done in a way that seriously undermined the goal of ensuring food security in the long run.

The global economy and, in particular, the food system, are wholly owned subsidiaries of the environment. Ignorance and denial of this fact, reflected in the tendency to subjugate environmental preservation to virtually all other perceived human needs and desires, exact a price much higher than generally appreciated. Human impacts already exceed Earth's long-term biophysical capacity to sustain present methods and levels of agricultural production.

Consider the condition of the planet's productive (vegetated) land surface, for example. In a recent study, I estimated that over 40 per cent of this land now has diminished capacity to supply benefits to humanity, due to recent direct human impacts of land use (not counting substantial indirect impacts, such as air pollution and stratospheric ozone depletion)[1].

This represents roughly a 10 per cent reduction in Earth's potential to yield direct benefits, such as agricultural, forestry, industrial, and medicinal products. The loss of this potential could eventually shrink to only 5 per cent if the socio-economic changes required to halt the degradation are taken swiftly, before natural recovery mechanisms are irreversibly impaired. Conversely, if present trends are allowed to continue, the loss could reach 20 per cent by the time Earth's population hits 8 billion.

Virtually every element of natural capital essential to agriculture is similarly affected. Indeed, at 5 billion people the human population was already consuming, co-opting, or destroying about 40 per cent of Earth's annual net primary productivity (NPP), the basic food supply of all terrestrial

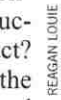
MARK EDWARDS/STILL PICTURES

animals.

A more recent, parallel analysis of availability of water indicates that today's 5.7 billion people now use over 50 per cent of Earth's accessible renewable runoff; the remaining portion must be shared by the millions of other life forms inhabiting the planet. Increasing human dominance of the biosphere is driving other species, the very basis of our agricultural system, to extinction – up to an estimated million times faster than the rate of evolution of new species.

Humanity has exploited the richest, purest, and most accessible soils, water, minerals, and other resources first and is moving to progressively poorer and less accessible ones. Even the most optimistic rates of technological innovation would be unlikely to offset the increase in environmental deterioration associated with projected population growth and the need to exploit ever lower quality resources.

Thus, the population-food debate might be refocused on the challenge of expanding Earth's social carrying capacity – the maximum sustainable population under a given socio-economic system. What socio-economic changes could most effectively increase individual material well-being, while holding constant or reducing total human environmental impact? What alternatives exist, given the momentum of population growth and patterns of both resource consumption and deployment of technologies?



REAGAN LOUIE

Humanity is faced with a huge array of possible paths. All sorts of policies have strong interactions with the agricultural system, directly for example, through farm subsidies, terms of trade or water pricing and indirectly through policies affecting land prices and labour markets and socio-economic equity.

Yet important obstacles strongly hinder the use of this array of levers. Paramount among them are powerful vested interests in the *status quo* which resists any changes that would cost them but benefit society as a whole. Thus some of the potentially most effective means of sustainably enhancing agricultural output are not pursued, such as increasing equity in opportunity – between the sexes, households, regions, and nations. For instance, gender-based inequity in access to farm credit, agricultural extension services, material inputs to farm productivity, and hired or child labour exerts a direct negative effect upon productivity. (In large parts of the world, women contribute much more farm labour than do men).

At the inter-household level, land reform that converted estates and industrial farms to large family farms would increase productivity in many circumstances. This is because, in general, family farmers operate under the incentive of maximizing production per hectare; large landowners, by contrast, profit most by maximizing production per worker. At the regional level, Lofchie aptly describes the wide-

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Far left: *Farming in Cameroon. Women farmers do most of the work but do not get the support they need.*
Left: *Burning the Amazon.*
Below: *Eroded land in Ethopia – 40 per cent of the earth's productive land is affected.*

spread suppression of the agricultural sector in developing nations as "a policy that unites the total ensemble of urban interests[2]." Indeed, there is substantial evidence that increasing equity at all levels would enhance agricultural output.

At present, we are instead taking the path of least resistance, ratcheting up the pressure on natural systems, whose largest constituency – the poor, the young, and the unborn – have little influence on the policy-making process. The danger of this path is masked by the lag-times, non-linearities, and irreversibilities inherent in the response of natural systems to perturbation. Moreover, when the prospects of changing the *status quo* appear too daunting, one is left with a gruesome tradeoff between saving a life, even momentarily, today versus providing

SEAN SPRAGUE/PANOS PICTURES

for many lives in the future.

Tragically, the *status quo* is further reinforced by the overwhelming diversity of opinion expressed in the agricultural literature, which contributes to paralysis in the policy arena. It is easy to see how this situation arose, considering the complexity of the food system. No one analyst can claim to understand all the pertinent aspects of the natural socio-economic systems in which agriculture is embedded: climate, soil, hydrology, biodiversity, epidemiology, ecology, energy, international trade, agricultural policy, social and economic policy in general, technology and culture. It is extremely difficult to formulate an integrated, holistic view of such a complex, highly interactive system.

Fortunately, absolute consensus on agricultural issues is not required, nor is it even a sensible goal. But making sound and forceful policy recommendations requires much greater interdisciplinary communication and collaboration. For example, it is absurd that so many interpretations of and forecasts based upon past trends in agricultural output ignore critical changes in the underlying basis of productivity. Economists are equally frustrated that assessments of the food situation by natural scientists so frequently ignore the influence of prices.

We are at a crossroads. Humanity now has the analytical tools and basic knowledge to discern the consequences of continuing on its present course. We are headed in the direction of increasing vulnerability to various unpleasantries, such as famine, mass migration, disease, and warfare, and at the same time rapidly foreclosing many of our best options.

The first test of whether we will apply our tools and knowledge to steer ourselves toward sustainability is whether the intellectual community, with comparatively little at stake, can pull itself together. ■

1. Daily, G. C. (1995), *Restoring value to the world's degraded lands*. Science, July 21.
2. Lofchie, M. F. (1987), *The decline of African agriculture*, in M.H. Glantz, ed., *Drought and Hunger in Africa*, Cambridge University Press.

Gretchen Daily is Bing Interdisciplinary Research Scientist at the Center for Conservation Biology, Stanford University. Dr Daily's research is at the interface of science and policy and spans topics from the ecology of birds and butterflies to socio-economic aspects of sustainability. She is the author with P. R. Ehrlich and A. H. Ehrlich of The Stork and the Plow *reviewed on page 32.*

An ever-green revolution

Instead of striving for a second Green Revolution – with its emphasis on new seeds, fertilizers and pesticides – an emerging case is being made for an ever-green revolution. This would be based on a belief that increases in yields are possible with sustainable farming methods that are management and knowledge intensive. ***Jules Pretty*** **introduces our field reports.**

MARCUS ROSE/PANOS PICTURES

Above: *Market gardening in Burkina Faso.*

Over the past 50 years, agricultural policies have successfully promoted external inputs as the means to increase food production. Pesticides have replaced biological, cultural and mechanical methods for controlling pests, weeds and diseases. Inorganic fertilizers have substituted for nitrogen-fixing crops, livestock manures, and composts. And information comes solely from suppliers, researchers and extensionists rather than building on local knowledge.

A more sustainable agriculture tries to do things differently. It pursues an incorporation of natural processes such as nutrient cycling, nitrogen fixation, and pest-predator relationships; a reduction in the use of external and non-renewable inputs that damage the environment or harm the health of farmers and consumers; a more equitable access to productive resources and opportunities; a greater productive use of local knowledge and practices; and an increase in self-reliance amongst farmers and rural people.

What has happened recently is that empirical evidence from the field is suddenly beginning to show that sustainable intensification works. Food output from the same land can be increased two to three fold, and sometimes more, with technologies and practices that do not damage the environment and that are accessible to all types of farming families.

Importantly, these breakthroughs have come on farmers' fields and in rural communities. We have long known that resource-conserving technologies will work in research stations, but somehow they have not been widely adopted by farmers. But now, as a result of agricultural professionals increasingly working with and learning from farmers, new productive options are being discovered.

The four cases described below point the way forward. Put farmers at the centre of agricultural and natural resource improvement, work with them and build on their knowledge, develop new partnerships between different agencies, and food production will improve immeasurably.

When these are put alongside some of the emerging evidence from elsewhere, it is clear that something important is happening. In Indonesia, 100,000 rice farmers have adopted integrated pest management, cutting pesticide use substantially but with no loss of yields; in southern Brazil, 38,000 farmers using green manuring and soil conservation have substantially increased crop yields; and in Kenya, the government is pioneering a participatory approach to soil and water conservation in 800 communities that has greatly increased cereal yields.

Most successes, though, are only islands of success. This is partly because favourable policy environments are missing. Most policies still actively encourage farming that is dependent on external inputs and technologies. It is these policy frameworks that are one of the principal barriers to a more sustainable agriculture.

It is also partly because many scientists still argue that the best way to feed the world is to focus exclusively on modern varieties of crops, breeds of livestock, fertilizers, and pesticides. They speak a language of loss when it comes to sustainable agriculture: low-input must be low-output. Yet these cases show there need be no loss when farmers' skills and ingenuity are put at the centre of efforts to increase food production.

What we now need is some visionary leadership, both in the North as well as the South. We await the first declaration of a national integrated policy for sustainable agriculture. This will smooth the transition to a sustainable and productive agriculture that can feed the world. ■

Jules Pretty is Director of the Sustainable Agriculture Programme at the International Institute for Environment and Development in London. His book Regenerating Agriculture: Policies and Practice for Sustainability and Self-Reliance *was jointly published by Earthscan Publications and the National Academy Press in April 1995, at £12.95.*

Permaculture: a natural way

by John Madeley

In a world that desperately needs to increase food output, and to sustain that increase, it makes sense to use what the natural world provides, in the best possible ways. Permaculture (permanent agriculture) allows for precisely that.

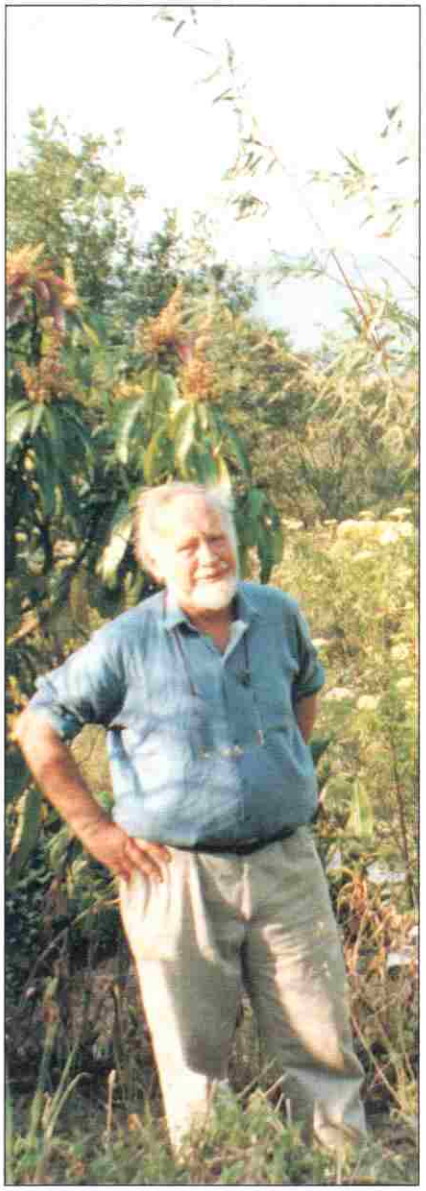
The idea is still relatively new. It was developed in Australia in the late 1970s by former shark fisherman Bill Mollison and has grown rapidly, especially in the last four years. By 1991 there were some 60 permaculture institutes, today there are over 140 in around 50 countries.

With permaculture, farmers use no inputs, such as chemicals, from outside the area where they farm. They grow a mixture of food and tree crops, and often keep small livestock, with each part of the system benefitting the other parts. Trees tap soil moisture, for example, leaf-fall from trees enriches the soil and helps crop growth.

"Farmers who switch to permaculture methods may go through a temporary dip in yields," Bill Mollison told me on his 5-acre farm near Brisbane, "but eventually they should produce much more. For a farmer who has been using chemicals on his land we devise about a five-year changeover time. We might suggest prosopis, mesquite or acacia (trees) so that yields increase while inputs reduce, because nitrogen and mulch are being provided."

"In some cases farmers need use only one quarter of the land to get the same yield. They can then use the other three-quarters of their land for rainfall harvesting – and it is on this land that farmers can devise systems of forestry which are very high in nutrients, so that we are getting all the fertilizer washed into the fields. And the farmer is then in a pretty steady situation, getting much higher yields with no chemical fertilizer or pesticide and with no pest problems. It all takes about 4 or 5 years. In some cases, farmers can do much better than a four-fold increase – sometimes up to 16 times as much has occurred!"

Training courses are a key part of the work of permaculture institutes throughout the world, and over 20,000 people have now received training. The Fambidzanai Training Centre in Zimbabwe, for example, offers two-week training courses to groups of up to 25 students.



JOHN MADELEY

Bill Mollison

The centre has a large variety of indigenous fruit trees in its garden, and also citrus fruit, tree tomatoes and peaches, with vegetables growing amongst the trees. "We grow Leucaena trees because they are leguminous and their falling leaves make excellent compost," said Shepherd Mpufumi, the centre's Chief Training Officer, "we grow some indigenous trees because we make insecticide sprays from their leaves, bark and wood."

"All the trees and vegetables in this garden are in a kind of symbiotic relationship," he said, "we try to keep the balance right between sunlight and shade, between pest and predator, because this is the way that healthy living is encouraged. We feed the soil and the soil feeds the plants. In this way the plant can decide what nourishment it needs. We never leave the soil exposed to the hot sun, we mulch it to keep it cool and damp. All plants and insects and animals, and we who tend the garden, live in a natural harmony."

Shepherd Mpufumi stresses that permaculture is suitable both for areas of good rainfall and for dryland areas. For people from dryland areas, Fambidzanai runs courses which aim to improve participants' skills in managing dryland cropping in a sustainable way, and also how to manage soil and water conservation, pest and disease prevention and control.

"What we are doing in permaculture institutes is re-stating information that works, based on thousands of trials and examples," said Bill Mollison. He estimates that probably well over 100,000 farmers are practising permaculture worldwide – an expansion has taken place largely outside of government institutions.

With high-yielding, sustainable agriculture a priority in today's world, it is surprising that government ministers, policy-makers, research institutes and even many academics, have been slow to pick up permaculture ideas. "I can only think that Ministers are not reading, not listening, not looking," believes Mollison. "Ministers are usually more interested in increasing the output of export crops. They are involved in trying to make money out of the land, and that's the main cause of land degradation. Governments don't understand sustainable farming; very few government ministers have any ecological or social training."

Pointing to the unsustainability of much "modern" agriculture, Bill Mollison pleads – "let's recognize that we are in a real emergency. By the year 2000, permaculture will be one of the very few things for people to build onto." ■

Permaculture Institute, PO Box 1, Tyalgum, NSW, Australia. Permaculture Institute (UK), PO Box 1, Buckfastleigh, Devon, TQ11 0LH, UK.

Restoring a fragile land

by Fatoumata Batta

Mano Kokoro is a 56-year-old farmer in Lantakoani, a village in Liptougou in Burkina Faso. He is head of a family of fourteen. He owns two hectares of land inherited from his father which he farms with his two wives and two eldest sons.

Kokoro had been farming on this land for more than 10 years though his output has been very low: crops could barely fill one small granary and his family has faced hunger throughout these years.

The land Kokoro tills is in one of the most deprived areas in Burkina Faso. Exploitation of the land has led to soil erosion. Rainfall in this region is the lowest in the country. During favourable years, the average production of cereals is 250-300 kg per hectare against 500-600 kg in other parts of the country.

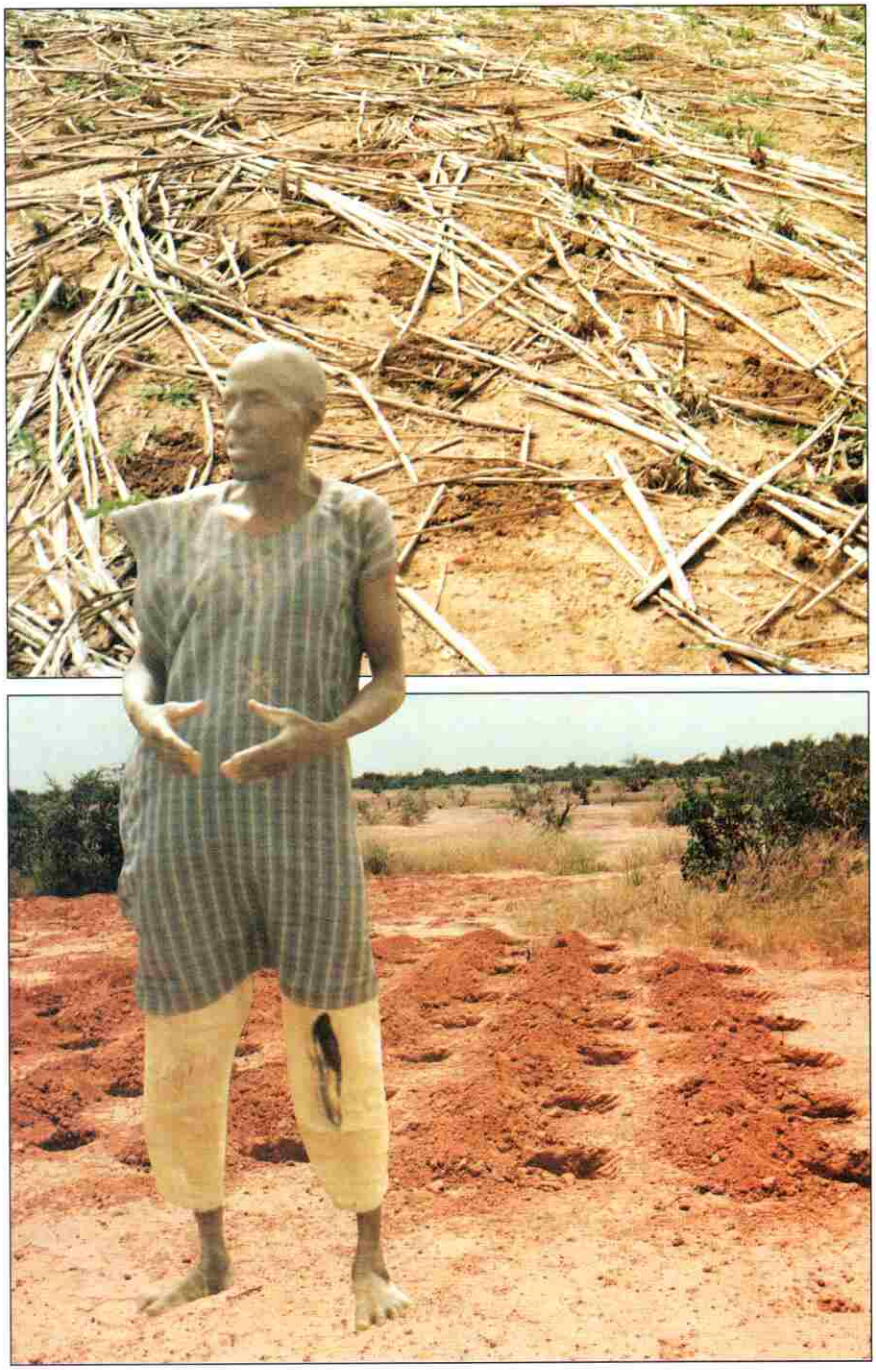
But now a new project run by the World Neighbours Programme has changed Kokoro's life. Started in 1989, the project aims through its 'self-help' approach to assist farmers like Kokoro to increase their yields and improve soil fertility.

The project team helps peasant farmers to conduct small-scale trials of new farming methods. These are assessed by peasant farmers themselves and by the villagers during inter-village evaluation meetings.

The programme's method is based on participatory needs assessment: farmers from all the villages get together to exchange ideas, share their problems and identify solutions. Participants then decide to retain for extension the tested innovations which solve problems of soil infertility and food security.

Kokoro was searching for more fertile land when he heard about the World Neighbours initiative. He decided to return to his village to try out the new methods.

"I have been using the 'zai method' for three years on an area of less than one hectare," says Kokoro. (This is a micro-catchment technique which involves digging small ditches, placing organic manure inside and then covering them with earth. When the rain comes, the seeds are planted in the ditches which retain soil humidity during droughts).



ALL PICTURES: FATOUMATA BATTA

"To protect the soil against strong winds I also spread millet stalks all over the land after harvest. I saw that this was efficient. Then I tried other techniques such as earthen bunds along the contour lines to prevent the erosion due to water run-off and also to maintain humidity in the field."

In addition, Kokoro has learnt how to construct manure pits for animal manure and crop leftovers. These are watered regularly. The resulting organic fertilizer is then spread on the fields.

Alongside these new farming methods, the project staff have introduced trials of short cycle seeds and Kokoro has selected sorghum which he is still successfully planting today.

"All these techniques allowed me to restart the farming of the 'bare parts' of my land that I had previously neglected. I have been able to restore the soil fertility and produce crops in places where I wouldn't have thought possible. My production output has increased," he says.

"My family and I no longer encounter hunger. I still have three granaries to go through the lean period

and these cereals will not be consumed before the next harvests in October–November," he adds.

Mano Kokoro is now the vice-president of the Village Development Committee (VDC). Members are village volunteers selected by their community. As village leaders they are responsible for conducting community-based activities in agriculture, as well as in health and community management.

During the dry season the board members of the VDC meet once a month to evaluate and plan activities to be implemented in the next month. At the end of each agricultural campaign they organize a village meeting gathering all community members together to assess their achievements. The community then decides as a group which new farming techniques to pursue or reject.

The success of the World Neighbours project hinges upon two main factors: self-help and community involvement. World Neighbours staff provide the necessary training and technical follow-up which in return strengthens the peasant farmers' skills and resources. They are then able to assess their needs and problems and implement solutions through the democratic structure of the Village Development Committee.

More importantly, World Neighbours has shown that degraded land can be replenished and agricultural productivity increased in a sustainable way.

The strength of the project has been due to this unique collaboration between development worker and farmer. But its long-term sustainabiltiy will turn on the competence and dynamism of the voluntary village leaders. They need continuing encouragement and support in this role. An appropriate way of giving this has yet to be found. ■

Fatoumata Batta is area representative for the World Neighbours Programme in West Africa. World Neighbours is a people-to-people non-profit organization working to eliminate hunger, disease and poverty in Asia, Africa and Latin America.

Hope for the future: 3

Planning for sons

by Syed Ayub Qutub

With average families of six or more children, the densely farmed irrigated part of the Punjab province in Pakistan, would not have been able to support its growing population without revolutionary changes in agriculture.

Villages in this area are in no doubt that without high-yielding seeds and more irrigation to water them, they would have seen much starvation from the 1960s onwards. As it is, HYV seeds and double cropping has increased production faster than population growth. At the same time, by not leaving the land fallow, waterlogging and salinity have been kept at bay.

But what will happen if population continues to grow at its present rate and why do parents continue to have such large families? Are there changes in farming systems which would also help to bring about changes in family size?

To help villagers explore these issues for themselves the Pakistan Institute for Environment-Developed Action Research (PIEDAR) has been working over the last three years in 25 villages of Kabirwala tahsil, in the Khanewal District of irrigated wheat-cotton belt of Punjab.

The aim has been not just to understand the situation, but to change it. Using participatory rural appraisal (PRA) the partner villages have begun to understand their situation better and to change their land and water use plans. And village organizations have been formed for collective action.

National surveys and village censuses confirmed the fact that the total fertility rate in the region exceeds six children per women. They also show that the reason is not a lack of information. More than 9 women out of 10 have heard of family planning, while 7 out of 10 know of a specific method. But fewer than 1 in 10 is practising contraception.

The traditional explanation for this gap between knowledge and action is religious taboos. But this does not suffice. Only a fifth of those not practising contraception mentioned religion as a reason, in a recent survey. Opposition by husband or mother-in-law is significant, but still only accounts for 15 per cent of couples. The desire for another son is by far the most important reason.

In fact, the evidence from our research suggests that uncertainty of land ownership or tenure could be an important determinant of ideal family size, especially in cultures where loyalty is owed only to the immediate family, rather than to the group. There is much uncertainty over land ownership all over Punjab Province, giving an advantage to those families with sons who can protect it. According to the National Commission on Agricul-

Left: *Mano Kokoro on his farm. Millet stalks protect the soil against strong winds. He uses the 'zai method' to plant seeds.*
Below: *Boys returning home from school, Punjab, Pakistan.*

SEAN SPRAGUE/PPF

Left: *A Patwari at work among decaying land records.*
Right: *Piet van IJzendoorn using worms on his farm.*
Below right: *The quinoa plant contains high quality protein.*

PIEDAR

ture, half the arable land is under litigation.

It also seems likely that a sharply peaking seasonal labour demand in multi-cropping high-input agriculture may affect family size preferences. The wheat-cotton cropping pattern, which is common in the area, imposes an intense workload during the wheat harvesting and cotton harvesting-wheat planting seasons. Hired labour becomes short and expensive. The farm family is so stretched that according to a common proverb it does not have time to bury its dead.

With population growth and division of land among widow and all children at inheritance, land records should be vital. But these records are kept by a junior revenue officer, or *patwari*, and are sadly dated and corrupted. A revenue officer says, "This is the last decade in which land records will be retrievable." It makes sense to have many sons to be able to physically hold onto the land in a situation where possession is nine-tenths of the law.

The reality of this situation has emerged from the detailed population-environment appraisal sessions which have been held with individual families. There is the landless labourer with eight children who now suffers from increasingly restricted access to free kindling, grasses and reeds. His wife can be helped to make a fuel efficient stove, while the husband can apply for a loan for a thatch-making machine.

There is the small farmer, one of five brothers, who fortunately has only two children after more than a decade of marriage. If his younger brothers follow suit, their land, with more intense use of inputs, may be just enough for the coming generation.

And there is the rich man, just back from the Middle East, with a family of 18, who wants to buy more land, but who concedes that this is not a solution for the whole village.

After the population-environment session, which has aired many contentious issues, (and doubtless brushed under some even more sensitive ones), the Village Organization selects a transect walk, noting for each land parcel what needs to be done to make it feed twice as many mouths as a present.

There is a steady stream of recommendations from those regarded as model farmers, many for more intensive application of fertilizers and other inputs, which may or may not be sustainable. There are also many suggestions for improvements which are not dependent on external inputs.

There is a sense of purpose about the deliberations, and one is left with an impression that doubling yields will not be a technically difficult proposition, provided village and family organization issues are sorted out.

A record of land improvement recommendations is kept, and the Village Organization makes an action plan, for step by step implementation, jointly and severally by the cultivators. Hopefully, a goal for family planning has been disseminated alongside.

Village fora exist, but have not before now seen discussions of this type. The villagers are quick to grasp the fact that one extended family's need may be complementary to those of another. Such an exchange can not only cut across social, traditional and hierarchical structures, it can lay the basis for a new network of economic relations. Traditional centres of power in a village are no longer seen as necessary to the economic functioning of the community. This itself is a breath of democracy in rural society.

If, as has been argued, the reproductive pattern of a rural society is conditioned not by tradition and irrationality, but by socio-economic necessity, then it too will change with the withering away of old necessities. However, the process left to itself is slow. Catalytic agents from the independent sector are needed. Meanwhile, civil society needs to be assured that the State will somehow manage to arrest the deterioration in the performance of basic governmental functions for maintaining law and order, and revenue records. ■

Syed Ayub Qutub is the founding Director of PIEDAR and co-ordinating author of Pakistan's National Conservation Strategy.

Hope for the future: 4

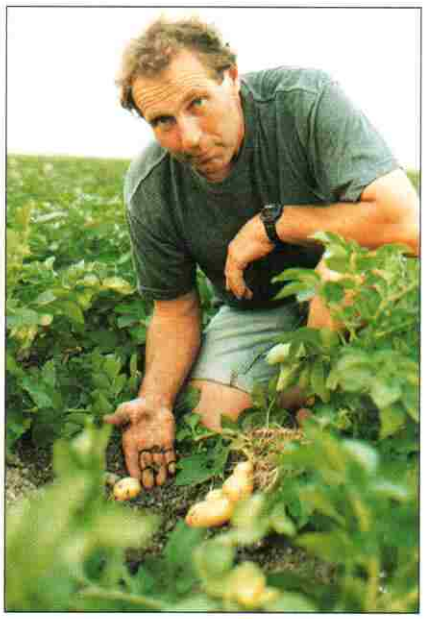
From nutcases to trend setters

Organic farming in the Netherlands is small, with no more than 500 farmers officially registered as organic. But their ranks are swelling by over 30 per cent a year. A recent study conducted by an agricultural journal found that one-third of Dutch farmers expect to be farming organically in the near future.

Most of them placed the ball in the consumers' court: if they would be prepared to pay for clean products, the majority of farmers would make the switch. The small minority who made the switch to organic farming years ago are therefore winning more and more respect. Their products are purchased by a wholesale company (which operates for profit) and distributed among the 400 health food shops that currently exist in the Netherlands. A large proportion of the produce is exported to countries like Denmark, where 20 per cent of all fruit and vegetables sold are organically grown. This is an astronomical figure compared to the Netherlands' one per cent.

One of the pioneers, in at the very beginning, was Piet van IJzendoorn. He started an organic farm on a polder that was reclaimed from the sea only in 1968. The polder was expected to produce enormous yields. The virgin land, three metres below sea level, was perfect for modern farming, and has some of the best soil in the world. Van IJzendoorn's farm 'De Zonnehoeve' was the odd man out on this new land. He used no artificial fertilizer and chemical pesticides, and his neighbours were surprised to see that this newcomer achieved similar yields to them. "Our results show that agriculture does not have to place great demand on resources, energy and the environment," says Van IJzendoorn. "We try to work using only the energy the sun gives us. That's why the farm is called 'De Zonnehoeve' (Sun Farm)."

Van IJzendoorn hopes to show that farming as it is currently known in the



PIET VAN IJZENDOORN

Netherlands is on its last legs. "Farmers import tapioca from countries like Thailand and Brazil and phosphorous from the Sahara to feed their animals," he says. "The worst thing is that we don't even use those nutrients properly." De Zonnehoeve does not get its nitrogen, phosphate and carbon from distant countries or from energy, but from the surrounding environment.

The three pillars of organic farming – clover, worms and cows – are essential. When he began, Van IJzendoorn spread a thousand kilos of worms on each hectare of land. Worms are unique in that they render the phosphate in the soil accessible to plants. Almost 80 per cent of the air around us is nitrogen. Leguminous plants such as clover and pulses absorb nitrogen from the air. Soil also requires cow manure, which comes from the 56 dairy cows kept on this mixed farm.

TOMMY MORRISON

Van IJzendoorn is no longer regarded as a nutcase. Two of his neighbours have now also switched to organic methods. Under pressure from the malaise in the agricultural industry, 60 farmers on the Flevopolder have followed the footsteps of this pioneer. They have set up study groups to help each other find appropriate solutions to their problems, for one thing is now certain: agricultural problems can no longer be solved simply by reaching for a toxic spray or sack of artificial fertilizer. Today's farmers must find creative solutions. ■

SOUTH AMERICAN PICTURES

This article first appeared in Environmental News from the Netherlands.

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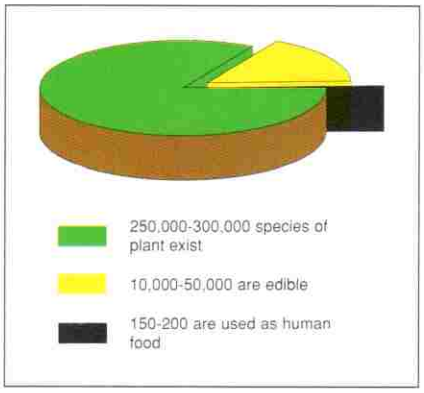
Forgotten foods

The press is full of reports detailing the annihilation of our planet's natural systems, and the corresponding loss of biodiversity. The full impact of this 'ecocide' has not yet hit us, but agronomists and plant breeders have been raising red flags for decades. Along with habitat destruction on a massive scale, has come the impoverishment of the wild genepool so vital for maintaining the health of cultivated food crops and domestic animals.

This is made worse by humankind's dependence on a tiny fraction of the food sources the earth provides. Despite 10,000 years of settled agriculture, and that fact that 50,000 species of edible plants have been identified, we use no more than 200 species on a regular basis. In fact, a mere 15 varieties account for 90 per cent of the world's food supplies, with just three of them – rice, maize and wheat – supplying nearly two-thirds of this amount.

Unexploited Biodiversity



These "Big Three" have emerged as the most important food crops on earth, providing a basic diet for more than 4 billion people. Rice alone feeds half of humanity. Although there are over 10,000 different species of cereals, no new ones have been introduced into cultivation for the past 2,000 years.

And what remains hangs by an incredibly fragile genetic thread. The overwhelming bulk of our cultivated food now depends increasingly on a rapidly shrinking gene pool. According to the UN Food and Agriculture Organization (FAO) in Rome, since the beginning of this century about 75 per cent of the genetic diversity of agricultural crops has been lost.

A similar process of genetic erosion has increased the vulnerability of domesticated animals to diseases. One in four livestock breeds found outside Europe are now thought to be at risk of extinction because of the impoverishment of the wild gene pool.

Genes from the wild are invaluable for plant breeders. When genetic uniformity left the US maize crop vulnerable to a blight that cost nearly a billion dollars in lost production in the 1970s, resistance was discovered in a wild variety of maize found only in East Africa. It is equally frightening to realize that one gene from a single Ethiopian barley plant protects California's $160 million barley crop from the yellow dwarf virus. In India, 10 types of rice are grown in an area that once harboured over 30,000 different varieties!

Furthermore, the erosion of the world's food security continues at an annual rate of 1-2 per cent.

Perhaps one way to compensate for a narrowing gene base, is to broaden the number of plants cultivated. Cultivation of roots and tubers, like cassava, yams and taro, which are important staples for around one billion poor people in the developing world, could be expanded easily. They are all nutritious foods, high in carbohydrates, calcium and vitamin C. Moreover, they are easily grown in the tropics, even on poor soils.

The other possibility is to bring back some of the world's forgotten foods, foods which were exploited in the past but lost out to modern agriculture. In a number of countries, particularly in the tropics, under-exploited, traditional food plants are being rediscovered.

Take the example of amaranto and quinoa, two grains that were cultivated by the Incas of Peru and the Aztecs of Mexico. Both have been rediscovered by agronomists. These two grains are versatile and nutritious foods, containing more high quality protein than most other commercial grains, including rice, maize and wheat.

There is a growing commercial market for both of these plants. Health food companies in North America and

Europe have already developed products based on both grains.

But these are only two of thousands of species that could be rediscovered and cultivated in commercial quantities. If we are to feed 8 billion people by 2020, it seems imperative that the world's food base be broadened considerably from the few varieties we now depend on. In fact, our very survival may depend on it. ■

Don Hinrichsen

Blossoms in the dust

Previous articles in this issue stress that in the coming decades, population growth and high income elasticities will increase enormously the quantitative and qualitative dimensions of the food security challenge.

Each year, the food and livelihood needs of an additional 90 to 100 million people will have to be met. Even if food can be produced, the purchasing power essential for access to balanced diets may not be available to the poor. Even now 11 million new livelihood opportunities need to be created each year in India alone.

Further, the damage now being inflicted on environmental capital stocks such as land, water, forests, biodiversity and the atmosphere will diminish chances for sustainable advances in agricultural productivity. There are already indications of a slowing down of the pace of progress in improving production and productivity both from the soil and the sea. Climate change and the increased incidence of ultraviolet-B radiation may further aggravate the problem. Also, affluence leads to a dietary transition resulting in greater demand for livestock products. This in turn leads to more arable land getting diverted to feed and fodder production. No new technological breakthroughs are in sight.

Based on such trends, many demographers and food experts feel that working to feed a population of 8 billion in the next century may already be a lost cause.

In my view, while realism is important, pessimism is dangerous. Where vision is limited, action is equally circumscribed. Before I explain why I am optimistic about achieving the necessary level of food security as well as the desired demographic transition, based on the recipe prescribed by Condorcet two centuries ago that population will stabilize itself when children are born not for existence but for happiness, let me refer to what I regard as the single gravest threat to achieving the goal of food for all. This threat comes from the growing violence in the human heart.

1995 has been declared as the International Year for Tolerance by UNESCO. Yet, intolerance appears to be the highlight of this year. The culture of violence is getting reflected in so many ways, ranging from violence to oneself (AIDS, drug addiction) to serious ethnic and social conflicts. Mega-conflicts are getting replaced by numerous mini-conflicts.

The root causes of these conflicts can often be traced to some of the principal features of contemporary developmental pathways, such as increasing rich-poor divide, jobless economic growth, damage to life support systems leading to the swelling in the number of environmental refugees and the rapid proliferation of urban slums arising from the loss or lack of livelihoods in villages. Above all, the growing feminization of poverty, leads to millions of children born each day remaining "blossoms in the dust".

Peace and social integration are essential for progress in any field and this is why I am apprehensive about the opportunities I wish to underline in this article being lost in a sea of despair and deprivation. We cannot afford to forget Mahatma Gandhi's point that we are unlikely to be non-violent to nature, if we are going to be violent to each other. Ethnic conflicts and trade wars also keep political leaders busy putting out bush fires, leaving them little time for concentrating on exterminating the root causes of the ecological and social fires engulfing our planet.

On the basis of a recent study, the International Food Policy Research Institute (IFPRI) in Washington DC, believes that by the year 2020 significant reductions can be made in poverty, food insecurity, malnutrition and micro-nutrient deficiencies and significant advances made toward efficient, effective and low-cost food and agricultural systems that are in harmony with the natural resource base.

The fact remains that although today the world produces enough food to feed each and every person, nearly 800 million children, women and men remain food insecure. The reasons for this tragic irony are to be found in the non-food sector, such as lack of purchasing power and entitlements, poor sanitation and health care and non-availability of clean drinking water.

It is therefore time that we redefine our concept of food security as *"livelihood security for the households and all members within, which ensures physical and economic access to balanced diets including the needed micro-nutrients, safe drinking water, environmental sanitation, basic health care and primary education"*. Such a redefinition will help to articulate the public policy package needed to ensure food security at the level of each individual in a household. The emphasis on individuals rather than on families is important, since in many societies women and girl children tend to suffer more from under – and malnutrition.

How do we achieve this goal? Action will be needed at the national, regional and international levels. At the national level, governments and local communities can jointly promote sustainable food and livelihood security through the following steps which could be appropriately integrated in the form of a *National Food and Livelihood Security Act*.

- Sustain the productivity of the natural resource base, by conserving and improving the ecological foundations essential for continuous advances in crop and animal productivity; in particular, urgent attention is needed to both arrest soil degradation and to restore the health of areas classified as *waste lands* (nearly 2 billion hectares of land have lost their fertility during the last 50 years and much of this land can be reclaimed).
- Ensure adequate availability of food by maintaining the growth in food production over population growth through the development and dissemination of ecotechnologies, supported by appropriate packages of services and public policies. Ecotechnology involves the blending of the ecological prudence and technologies of traditional farm families with the best in frontier technologies, particularly biotechnology, information, space and renewable energy technologies, and management technology. Ecotechnologies are essential for producing more farm products per units of land, water, time and energy on an environmentally

and socially sustainable basis.

- Ensure adequacy of household incomes through promotional social security, such as agrarian reform that would improve the livelihood security of poor families, enlarged opportunities for non-farm employment and remunerative marketing arrangements.
- Provide socially and economically vulnerable groups with entitlement to food through protective social security measures such as food for work and food for nutrition programmes and an efficient public distribution system capable of reaching the unreached.
- Promote at the local and national levels broad-based coalitions comprising representatives of relevant government and voluntary organizations, corporate sector, financial institutions, women's organizations, academia and mass media, to bring about convergence and synergy among diverse and often parallel efforts designed to achieve a sustainable end to hunger, *and*
- Build and maintain adequate food security reserves in a manner that distress sale and panic purchase can be avoided during years of surplus and scarcity respectively.

While further intensification of agriculture in industrialized countries will be environmentally disastrous, failure to achieve sustainable intensification and diversification of farming systems will be socially disastrous in developing countries, since import of food by predominantly agricultural developing countries will have the same impact as importing unemployment. It will however be advisable for all countries where farming holds the key to food and livelihood security, to ensure that both technology and public policy promote an *ever-green revolution* rooted in the principles of ecology, equity, employment and economics.

Both in agriculture and aquaculture, we should distinguish between green and greed revolutions. Sustainable green revolution is an economic and ecological necessity in countries with predominantly small farm holdings, so that small producers can earn more through a larger marketable surplus. The excessive use of chemical fertilizers and pesticides or the indiscriminate destruction of coastal biodiversity and ecosystems for undertaking intensive prawn/shrimp farming is best described as *greed revolution*. Failure to distinguish between green and greed revolutions causes confusion in the public mind and can harm food and livelihood security because of wrong response from the political and administrative systems.

While public action at the national level is essential for the elimination of poverty and hunger, global commitment to achieving freedom from hunger is equally important under the fast spreading market economies. Since 1990, the international community represented through the United Nations and its specialized agencies, has committed itself to a Charter for the Child (New York, 1990), Climate and Biodiversity Conventions (Rio de Janeiro, 1992), Human Rights (Vienna, 1993), Population Stabilization (Cairo, 1994), Desertification and the Law of the Sea Conventions (1994) and Poverty Eradication and Social Integration (Copenhagen, 1995). In September 1995 at Beijing there was a re-affirmation of the need to accelerate the pace of progress in achieving gender equity and in ending all forms of discrimination against women.

A review of all these Conventions and declarations will provide the basic ground rules for a happy and hunger-free world. The Food Security Summit which FAO proposes to organize during 1996 may be a good occasion for all member nations of the UN to commit themselves to a *Global Convention on Sustainable Food and Livelihood Security*, consisting of the following major provisions.

- Implement both in letter and spirit the plans of action agreed to at recent UN Conferences, particularly at Rio, Cairo and Copenhagen and take speedy action to implement the provisions of the Desertification Convention.
- Ensure adequate support for research and development efforts designed to promote national and international public good, since the fast spreading Intellectual Property Rights (IPR) environment is likely to promote greater investment only in short term and profit-driven research. Integrating the dimension of sustainability in research objectives, will involve location-specific and participatory research with rural families.
- Ensure the rapid dissemination of environmentally sound agricultural technologies, particularly among resource-poor farm families.
- Promote increased trade in value-added agricultural commodities produced in developing countries by helping them to improve post-harvest technology and measures to ensure that pests and diseases do not spread from one country to another, *and*
- Contribute generously to global emergency food security reserves and to food for livelihood security programmes through the World Food Programme and other appropriate social security programmes.

Doomsday predictions would serve a useful purpose if they help to trigger media attention and public action designed to ensure that such predictions do not come true. This is what happened in the early 1960s, when India, Pakistan and many other developing countries decided that must become bread baskets and not remain as basket cases. On the eve of the new millennium, we need a similar resolve on the part of individuals, nations and the global community so that we can promote an environment in which children are born for happiness and 8 billion children, women and men can go to bed well-fed. ■

MARK MCEVOY/PANOS PICTURES

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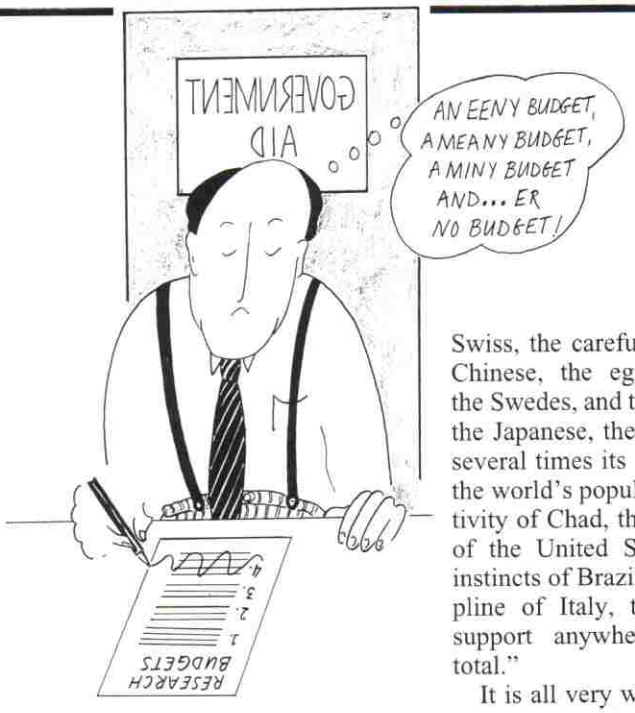
The screw-up factor



Sure we can feed 8 billion people, and do it endlessly. But only if we do just about everything right for just about all the time. Governments are disinclined to do even half of things right for even half of the time. They are masters of messing things up.

Here, then, is an item – which Gadfly designates the screw-up factor – that should be incorporated into all calculations about the vital question of how many people we can feed. When was the last time you heard the optimists make allowance for this constraint?

Twenty years ago Paul and Anne Ehrlich and John Holdren produced their famous assessment of our environmental predicament, which implicitly included our capacity to feed ourselves. They devised an equation, I = PAT, where I stands for environmental impact, P is population, A is affluence or material welfare, and T is negligent technology. The last three variables operate in a mutually amplifying relationship; that is, you don't just add them, you multiply them together (wow).

It's a statement of where we're really at. Except that, Gadfly believes, it omits a vital component: our capacity to get things wrong, a capacity that governments seem to display with ever – greater commitment and ingenuity.

Consider, for instance, investment in developing-world agriculture. Rich nations' aid fell from $12 billion in 1980 to $10 billion in 1990. Even more critical is funding for agricultural research. You would think that he who tries to get two bushels to grow where formerly there was one would have money thrown at him. Far from it.

The International Research Centres were once the powerhouses of the Green Revolution. They did it off a collective research budget of typically $150 million a year – peanuts, as it were, in light of the return on the investment. Having achieved a series of plant-breeding miracles and saved entire nations from starvation, they have now found their budgets slashed by 10 per cent in real terms since 1992.

Why? Because governments in their wisdom no longer make a top priority of seeing that billions of people are fully fed. This is all the more tragic in that the Green Revolution seems to have run out of steam, and per-capita cereal production is lower today than at any time since 1975.

In similar screw-up style, the Sahel has regularly increased its agricultural productivity since the onset of its famines, but much of the extra output has been peanuts and cotton for export. Hence the Sahel still starves. Farm credit in developing countries primarily goes to those who don't need it. Funds for rural development often end up in cities, where most development money gravitates.

This is not to be defeatist. It is to be realistic. Consider a recent government goof of the first order. No government anticipated the 1989 economic recession, even though it turns out to have been apparent enough in the financial tea leaves. The reader can surely think of stacks of other screw-ups. Yet government leaders insist they take only an occasional wrong turning on the road to the promised land. To cite Dire Straits, "Denial is not just a river in Egypt".

So agricultural experts should not suppose the world is governed by the wise. Nor will it be peopled with saints and angels by next Monday. Yet we are implicitly urged to have full faith in our present leaders by the proponents of "feed the more masses."

The whole thing – as is the case with many population/environment problems – boils down to a series of monumental "ifs." It is akin to that prime piece of policy analysis: "If the world's population had the productivity of the Swiss, the careful consumption of the Chinese, the egalitarian instincts of the Swedes, and the social discipline of the Japanese, the planet could support several times its present population. If the world's population had the productivity of Chad, the consumption habits of the United States, the egalitarian instincts of Brazil, and the social discipline of Italy, the planet could not support anywhere near its present total."

It is all very well for academic analysts to tell us that farmers are far from achieving the theoretical maximum harvests that croplands could produce. How many of these analysts achieve anywhere near perfection in their own activities?

If anyone doubts Gadfly's thesis, let them ponder the last ten years – ten lean and hungry years for half a billion people. During this period (a transient blip or a solid pattern?), the world's farmers have not nearly kept up with the world's population growth. Result, the world's enfamished have had less and less to put on the supper table. In fact, there is a larger number of people than ever who are chronically malnourished (translation: semi-starving). What real-world evidence is there that their total will not keep on growing for a bad while to come? True, there is now a smaller proportion of people who are fed up with being unfed on average. But try telling an Oxfam-photo child that he or she should "think average".

During the last quarter century we have lost 300-400 million people to hunger and related diseases. It is the biggest mass starvation in history, and it keeps getting worse. If we can't feed 5.7 billion people, shall we ever be able to do it for eight billion people?

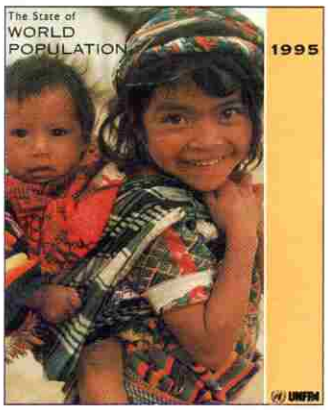
For an answer, go and ask those multitudes, comprising every sixth person on Earth, who will not consume as much quality protein this week as a cat in Britain enjoys every day, and who will not see as many calories during the whole of today as many of us will see by halfway.

If we are to surmount the population/food challenge, should we not put as much faith in family planners as in farmers? ■

Associates' NEWS

Plan for life

Investing in people is the key to sustained economic growth and sustainable development, as well as to balanced, sustainable population growth, says this year's *State of the World's Population* report from the United Nations Population Fund.



The report says that the Cairo Conference's explicit 20-year goals for expanded access to education, particularly for girls; reduced mortality rates; and increased access to quality reproductive health services, would promote social and economic development, and help achieve population growth rates that the world can accommodate.

According to the report, one third of the illness among developing country women aged 15–44 is related to pregnancy, childbirth, abortion, HIV and reproductive tract infections. High levels of maternal mortality and poor maternal health are closely related to the low social and economic status of women.

The report shows that there is a direct connection between education for girls and women's ability to escape from poverty; education also leads to later marriage and greater use of contraception. It is associated with lower maternal mortality, with smaller, healthier families.

Men should be encouraged to take responsibility for their sexual and reproductive behaviour and for household obligations, and to allow women to become equal partners in public and private life, the report adds. Worldwide, some 350 million couples lack access to a full range of modern family planning services and information. An estimated 120 million women would practise family planning if a modern method were available, affordable and acceptable to their partners, families and communities.

World population is currently 5.7 billion and UN projections for 2015 range from 7.1 billion to 7.8 billion, and for 2050 from 7.9 billion to 11.9 billion. The actual totals reached will largely be determined by success in implementing the goals of the ICPD Programme of Action during the rest of this decade.

The document urges all countries to make reproductive health care and family planning accessible through the primary health care system to all individuals of appropriate ages no later than 2015. The financial resources required for this effort in developing countries and those with economies in transition are estimated at $17 billion for the year 2000.

■ *For copies of the report contact, The Information Division, UNFPA, 220 East 42nd Street, New York, NY 10017, USA. Tel: 1 212 297 5026. Fax: 1 212 557 6416.*

Health risks

According to a new PAI study, *Reproductive Risk: A Worldwide Assessment of Women's Sexual and Maternal Health*, health risks faced by women in sexual activity and childbearing vary enormously from country to country. About 1.3 million women still die each year from largely preventable, reproductive health causes – nearly all of them in developing countries.

A woman in Italy, the best ranked country in the study, faces only a 1 in 17,000 risk of dying from causes related to pregnancy and childbirth over the course of her lifetime. For a woman in Zaire, the worst ranked country, the risk is 1 in 16, more than 1,000 times greater.

While access to medical care in pregnancy and childbirth is close to universal in the industrialized countries, worldwide only slightly more than half of all births are attended by any kind of trained personnel. In Nepal, Afghanistan and Somalia, fewer than 10 per cent of women receive prenatal care or have the help of a trained attendant at the time of delivery.

In the countries with the lowest reproductive risk – Italy, Denmark, Norway and Sweden – the factors contributing to good reproductive health include low teen birthrates and small family size overall, nearly universal access to maternal health services, high levels of contraceptive use, low levels of infection with HIV and access to safe abortion on request.

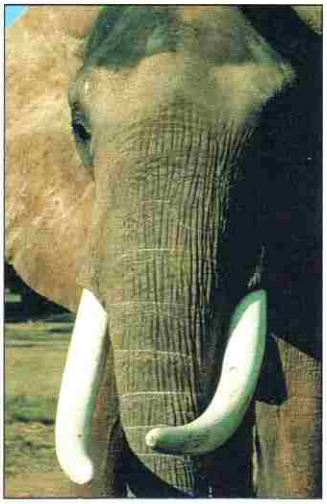
In the three worst ranked countries – Zaire, Angola and Somalia – more than one-fifth of 15–19 year olds give birth each year and women have, on average, close to seven children. Most women lack access to basic health care in pregnancy and childbirth, fewer than 10 per cent of women use any method of family planning and abortion is illegal or permitted only to save a woman's life.

"A comprehensive approach to reproductive health is urgently needed," says Shanti Conly, editor of the study and PAI's director of policy research. "Access to modern methods of contraception can dramatically reduce the number of unwanted and high-risk births. To reduce maternal death rates, however, women must also have access to emergency medical during childbirth and alternatives to unsafe abortion."

■ *For copies of the report contact: PAI, 1120 19th Street NW, Suite 550, Washington DC 20036, USA. Tel: +1202 659 1833, Fax: +1202 293 1795.*

Elephant update

African elephants may still be facing serious threats to their long term survival,



D LAWSON/WWF UK

according to a field study released by the World Wide Fund for Nature (WWF), the World Conservation Union (IUCN) and the US Fish & Wildlife Service. The study says that massive reductions in African government conservation and law enforcement efforts may be leaving elephants increasingly at the mercy of poachers.

"Unless the shortfalls can be addressed now, African elephant conservation will lose the critical ground it has gained," said WWF senior conservation adviser Holly Dublin, co-author of the report, *Four Years after the Ban: Illegal Killing of Elephants, Ivory Trade and Stockpiles* with Tom Millken

of TRAFFIC and Richard Barnes.

■ *For further information, contact Dana Lauren West, WWF-US, at: +1 202 778-9509, or Javier Arreaza, WWF International, at +41 22 364 9575.*

Ensuring quality

The Tanzanian Ministry of Health and the national family planning association UMATI are collaborating with AVSC International and other organizations to improve the quality of family planning services offered in clinics and hospitals. To develop quality assurance standards and national supervisory systems, AVSC is training supervisors how to manage quality improvement.

A critical problem in the region is a chronic shortage of trained personnel. AVSC is tackling this by helping supervisors and service sites make better use of available resources through self-assessment and the introduction of on site skills training.

In 1994, AVSC worked in 40 sites that served over 5,000 clients. In the past three years, almost 12,000 clients have obtained long-term and permanent contraception through the AVSC-supported programme.

■ *For further information, contact Joseph Dwyer or Grace Wambwa, AVSC International, PO Box 57964, ABC Place, Waiyaki Way, Nairobi Kenya. Tel: +2542 444922, Fax: 441774.*

Speaking out

Audience participation is the key element of the *Youth Variety Show*, a new radio call-in programme in Kenya. The show's live, interactive format encourages young people to phone or write in with their questions about sexuality, postponing pregnancy, and reducing sexually transmitted diseases.

Every Saturday morning the one-hour programme is broadcast live throughout Kenya. Celebrities, health specialists, peer role models, Kenyan youth and parents discuss the week's topic from the studio. They assist the host, Elizabeth Omollo, a well-known and popular Kenyan broadcaster, in answering and discussing callers' questions.

Producers make monthly trips outside Nairobi to record dramas, interviews, and discussions with youth for broadcast. The resulting dialogues promote sensible, responsible sexual and health behaviour among young people and self-confidence in their own decisions.

The show's high-volume response has exceeded all expectations. All three studio phone lines are in constant use for several hours before, during and after every programme. Calls and letters from youth and parents all over Kenya express opinions, request information, and voice appreciation. One young person wrote, "Thanks for introducing this fantastic programme for youth."

The *Youth Variety Show* is a 26-episode pilot programme of the Youth Initiative Project, sponsored by the Family Planning Association of Kenya with technical assistance from the Johns Hopkins Population Communications Services Project and produced by the Kenya Broadcasting Corporation (KBC). The overwhelming support for the programme from youth, parents and KBC bodes well for its continued success.

■ *Contact, JHU, Centre for Communication Programmes, School of Hygiene and Public Health, 111 Market Place, Suite 310, Baltimore, MD 21202-4012, USA. Tel: +1410 659 6300; fax: 659 6266.*

South to South

Through its three regional offices in Africa, Asia/Near East and Latin America, Pathfinder International has fostered South to South collaboration by expanding family planning monitoring and evaluating systems between and within regions.

In Brazil, with the Women's Health Division of the Secretary of Health in the State of Bahia (SESAB), Pathfinder is developing a continuous assessment and monitoring system (SISMAC). The system is also being used to monitor indicators related to the postpartum/post-abortion family planning programme in Brazil.

Pathfinder International designed SISMAC as a simple and user-friendly system that answers common questions asked by family planning programme managers regarding programme performance. These include:

- the extent to which service targets are being met;
- the size and growth of the client population;
- the assessment of current and past levels of services by method, and
- the performance of health units, clinics, or workers relative to each other. The system also assesses how current productivity compares to previous periods.

In Bangladesh, Pathfinder has adapted SISMAC for collaborating agencies to measure quality of care indicators for family planning and reproductive health programmes. In Matamoros, Mexico, the system is being used by Pathfinder to monitor the performance of community-based distribution (CBD) workers at all staff levels including promoters of family planning methods, coordinators of distribution, and supervisors of family planning CBD programmes. It is also being implemented in family planning programmes in seven geographic regions of the Mexican state of Tamauilpas.

■ *For further information contact, Betsy Ziobron, Technical Communications Unit, Pathfinder International, Nine Galen Street, Suite 217, Watertown, MA 02172-4501, USA. Tel: +1617 924 7200. Fax: 924 3833.*

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FILMS

Quiet revolution

Poor soil and soil loss are major factors affecting the sustainability of food production around the world and frequently it is established farming methods causing the problems. Reynaldo Andino, a Honduran farmer struggling to make his mountainside fields productive, is the subject of one of six half hour stories in the series *The Quiet Revolution*.

Like most farmers in his region, Reynaldo used to burn off the previous year's crops saving him time but ruining the productivity of his fields. Now he and a group of local farmers are discovering new regenerative techniques through the World Neighbours organization, an initiative dedicated to improving the welfare of farming communities in Honduras. Gradually, eroded hillsides are coming back to life – and Reynaldo's enthusiasm and neatly contoured fields have become an inspiration for his neighbours.

Science for survival

Does science and technology hold the key to providing secure, stable and sustainable sources of food for a growing world population into the next century and beyond? Not according to Vandana Shiva, the Indian nuclear physicist-turned-environmental activist, whose views on the way forward for India's agriculture are outlined in a new 50-minute documentary produced by the International Broadcasting Trust (IBT).

In *Science for Survival*, Shiva argues that India, and other developing countries which have ancient and sophisticated cultural histories, should rediscover their own traditional knowledge systems rather than looking to western science for ways of creating sustainable agricultural and economic development. As one of India's most vocal leaders of India's growing movement of traditional farmers, she speaks out against the practices of the 'green revolution' – the cultivation of vast fertiliser and pesticide monocultures – which are pushing locally adapted and diverse crop species into extinction.

Added to that is the concern that too much power is being taken from the farmers and placed in the hands of the seed and chemical companies.

Over the course of several millennia, India's traditional farmers, have accumulated a wealth of detailed knowledge, on crop cultivation, pest control, and seed storage and selection. As the film shows, this knowledge is still available among the traditional farming community and it is women farmers who hold the key to rediscovering and reasserting its status.

Plant diversity

TVE, in association with the Consultative Group on International Agricultural Research (CGIAR) and Acacia Productions is developing an eight-part series exploring the planet's plant biodiversity, and the role of both traditional farmers and agricultural scientists in conserving it. *Nick Rance*

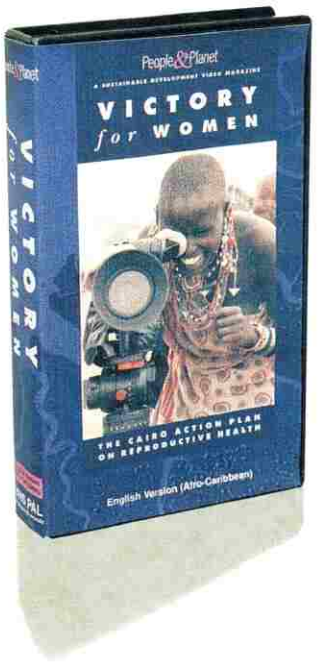
■ *All these films are available through TVE, Prince Albert Road, London NW1 4RZ, UK. Tel: + 44 (0)171 586 5526, Fax: + 44 (0)171 586 4866. Email: TVE-UK@GEO2.POPTEL.ORG.UK.*

VIDEOS

Available soon. The first three half-hour *People & the Planet* videos focusing on the new horizons opening up for women. These films will be released in four language versions.

Victory for Women
Reports on the new directions set by the Cairo Conference on Population and Development. Women in Egypt and Colombia speak out about the need for reproductive health care.

Learning for Life
Looks at the way education for women and girls is liberating their lives. With reportage from Senegal and Bangladesh.



Women: Calling the Shots
Reports on women worldwide campaigning for social change. With film reports from India and Jamaica on new ways of communicating.

For further details and prices please circle the video you are interested in and the language version you require.

Victory for Women	Afro-English
Learning for Life	Asian English
Women: Calling the Shots	Afro-French
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BOOKS

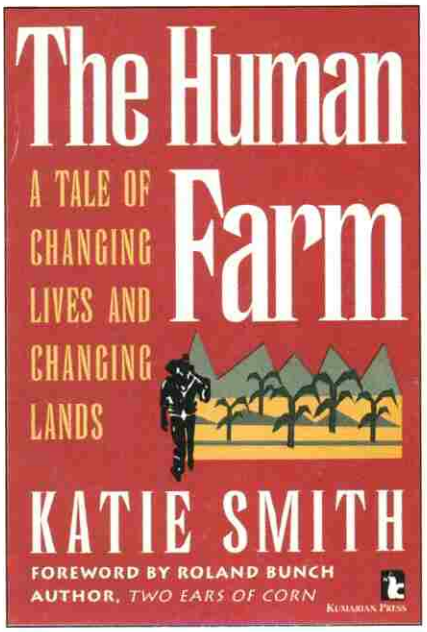
The human farm

The Human Farm. A Tale of Changing Lives and Changing Lands
Katie Smith
Kumarian Press, 1994. $14.95

The Stork and the Plow. The Equity Answer to the Human Dilemma
Paul R Ehrlich, Anne H Ehrlich and Gretchen Daily
Grosset/Putnam, New York, 1995. $30.00

So much writing about 'development' is as dreary as that almost meaningless word, that it comes as a blessed relief to pick up a book as readable as *The Human Farm*. It transports the reader into the world of the peasant farmer, it introduces living characters and it reveals truths which stick in the mind and enrich understanding.

It no doubt helps that Katie Smith cut her teeth in mainstream journalism. There is much good investigative reporting in this book. But there is also a sympathy with the subject matter which adds depth and richness to the story she has to tell.


The Human Farm
A TALE OF CHANGING LIVES AND CHANGING LANDS
KATIE SMITH
FOREWORD BY ROLAND BUNCH
AUTHOR, TWO EARS OF CORN
KUMARIAN PRESS

That story is about Loma Linda – a training farm for peasant farmers – and its influence on the hillside farming families in Honduras and their land. There is a large cast of characters, usefully listed at the outset. They include Elias Sanchez, the dedicated teacher who founded Loma Linda, Fernando and Vilma Andrade, a peasant couple bound by machismo and tradition who learned the hard way to improve their land, and Milton Flores, a well educated agronomist who has dedicated his life to conservation and the small farmer.

'Human farming' is a term Don Elias invented to describe innovative, loving, hard work to cultivate living soil. And it is something desperately needed in Honduras where two-thirds of the farms are located on a hillside with a more than 20-degree slope and with poor, clay-ridden soil.

On these slopes 2.8 million of the country's 4.4 million inhabitants scratch a living, with 93 per cent of rural households living on less than $24 a month. In 1980 the average rural family had eight children, and in 1990 nearly half those under five were malnourished.

In these circumstances, hope lies in people-centred development: "a philosophy which puts transforming people at the heart of transforming rural communities" as Roland Bunch puts it, in his Foreword.

This book details how that can be done, how the teachers and those that they have inspired, have together transformed the psyches of tens of thousands of poor farmers on as many acres of farmland in Central America.

Don Elias turned a patch of hillside wilderness just half an hour from the capital into his demonstration farm. Here campesinos have relearnt ancient terracing techniques and many other simple, appropriate technologies which make maximum use of water and of organic matter. They have learned how to create seedbeds in old car tyres, to control pests and fix nitrogen.

But the real goal, according to Don Elias, is "to get peasants to work with the resources of their 'human farm' – their heads, their hands and their hearts. That's the real secret of development."

In a world with two billion village farmers, the messages in this book – which include the importance of educating women and helping strengthen the revenues of poor communities so that poverty and 'over-population' can both be remedied – are vitally important ones.

They find echoes in the latest book from the Ehrlichs with Gretchen Daily, which tackles the inter-related issues of population and food.

While acknowledging the role of technology in increasing the global harvest, they also believe that the greatest potential gains could be achieved "through restoration of productivity of degraded lands and the development of 'alternative' agriculture, including improvements of traditional crops and farming techniques."

But the authors break new ground in attempting to tackle the broader question of injustice in the world. "The most fundamental change required" they say "is to increase socio-economic equity at all levels of the global agricultural system: between the sexes, between rural and urban regions and economic sectors, and between nations."

They argue that "much more investment must be directed towards the world's poorest farmers to halt the downward spiral of population growth, poverty and environmental destruction . . . Narrowing the vast gulf between rich and poor will be essential for feeding all of humanity and establishing a sustainable society."

This is a brave and lively attempt to broaden the debate about the coming race between the stork and the plough. The authors have culled a vast literature and have tried manfully to broaden the usual perspective of the food debate to take in population, consumption and environmental trends, and to link these with the issues of equity which are so often dodged.

The result, in the end, is an inevitably generalized wish list for future action, both political and personal. The equity issues raised here call for much more detailed consideration. Hopefully this stimulating book will set things moving.

John Rowley

Saving our ocean planet

The Wealth of Oceans
Michael Weber and Judith Gradwohl
W W Norton, New York, 1995. $25.00

Finally we have a book detailing the challenges facing our oceans and coastal areas that makes the big connections. Written to accompany the Smithsonian Institution's impressive roving exhibition, 'Ocean Planet', the book reviews what we know, but have too often forgotten, about the key interactions between the world ocean and the land it has helped to form. In ten chapters the authors weave a compelling narrative about these connections.

Writing in the first chapter, which takes the reader through the entire history of the Chesapeake Bay – the largest brackish water estuary in the United States – the authors note:

"As in the Chesapeake Bay, so in many other coastal areas of the world – settling and working the land along the coasts has fundamentally altered the relation between land and sea. In many watersheds, we first disrupt the mosaic of forest, wetland, and meadow that capture, confine, and store storm waters, nutrients, and soil. Then, with our communities flooded and streams polluted, we seek to recover those critical functions with expensive engineering works that often offer only partial solutions. Working with the land would be less expensive and better for coastal waters especially. Conservation of the sea cannot be secured apart from conservation of the land."

The book ends with a long-term agenda for safeguarding our "ocean planet" – actions that are critically needed if we are to salvage our seas and coastal areas from mounting degradation. Understanding must precede action; and this book provides a sound basis for comprehending the complex issues facing us, as well as pointing the way ahead.

Don Hinrichsen